PRODUCT/PROCESS CHANGE NOTIFICATION

PCN APM-DIS/09/4781
Notification Date 08/19/2009

APM - ASD & IPAD Division

Protection Devices in SMA/B/C & STmite

Conversion to ECOPACK(r)2 grade - Die design

optimisation of Transils in SMA/B<100V

Table 1. Change Implementation Schedule

Forecasted implementation date for change	28-Aug-2009
Forecasted availabillity date of samples for customer	12-Aug-2009
Forecasted date for **STMicroelectronics** change Qualification Plan results availability	12-Aug-2009
Estimated date of changed product first shipment	19-Nov-2009

Table 2. Change Identification

Product Identification (Product Family/Commercial Product)	Protection Devices in SMA/B/C & STmite packages
Type of change	Multiple types of changes
Reason for change	To meet environmental and technical requirements of the market
Description of the change	The ECOPACK(r) program is the cornerstone of our efforts for being leader in offering environmentally friendly packaging. Progressing in this program, ST is implementing technical solutions designed to progressively remove banned substances from manufacturing. To meet the so called "Halogen-Free" requirements of the market, ST is converting its Protection Devices in SMA/B/C and STmite packages to the ECOPACK(r)2 grade. The permanent evolution of our technology leads us to implement at the same time a die design optimization for our Transil products housed in SMA and SMB packages with voltage inferior to 100V.
Product Line(s) and/or Part Number(s)	See attached
Description of the Qualification Plan	See attached
Change Product Identification	By product marking, QA number and internal codification
Manufacturing Location(s)	

Table 3. List of Attachments

Customer Part numbers list	
Qualification Plan results	

- -

Customer Acknowledgement of Receipt	**PCN APM-DIS/09/4781**
Please sign and return to STMicroelectronics Sales Office	**Notification Date 08/19/2009**
☐ Qualification Plan Denied	Name:
☐ Qualification Plan Approved	Title:
	Company:
☐ Change Denied	Date:
☐ Change Approved	Signature:

Remark

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DOCUMENT APPROVAL

Name	Function
Paris, Eric	Division Marketing Manager
Duclos, Franck	Division Product Manager
Cazaubon, Guy	Division Q.A. Manager

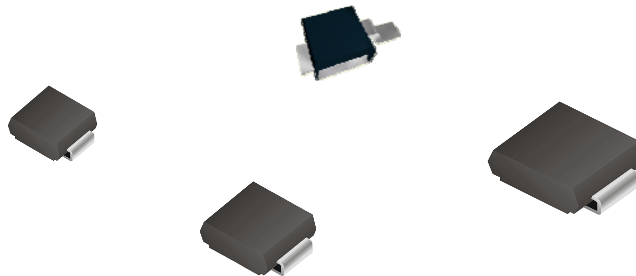
PRODUCT/PROCESS
CHANGE NOTIFICATION

PCN APM-DIS/09/4781

APM - ASD & IPAD Division[1]

Protection Devices in SMA/B/C & STmite packages:

Conversion to ECOPACK®2 grade - Die design optimisation of Transils in SMA/B for voltages < 100V



(1) APM: Analog, Power & MEMS Group - ASD: Application Specific Device - IPAD: Integrated Passive and Active Devices

WHY THIS CHANGE?

The ECOPACK® program is the cornerstone of our efforts for being leader in offering **environmentally friendly packaging**. Progressing in this program, ST is implementing technical solutions designed to progressively remove banned substances from manufacturing.

To meet the so called **"Halogen-Free"** requirements of the market, ST is converting its Protection Devices in **SMA/B/C and STmite packages** to the **ECOPACK®2** grade.

The permanent evolution of our technology leads us to implement at the same time a **die design optimization** for our **Transil** products housed in **SMA** and **SMB packages** with **voltage inferior to 100V**.

The **involved product** series are listed below:

Package	Product series	ECOPACK®2 conversion	Die design optimization
SMA	SMAJxxA-TR	All	SMAJ5.0A-TR…SMAJ70A-TR
	SMAJxxCA-TR		SMAJ5.0CA-TR…SMAJ70CA-TR
	SMA6JxxxA-TR		n/a
	SMA6JxxxCA-TR		n/a
	SMP30-xxx		n/a
	SMP50-xxx		n/a
	SMTYxxxA		n/a
SMB	LNBTVSxxxU		n/a
	SM6TxxxA		SM6T6V8A … SM6T75A
	SM6TxxxCA		SM6T6V8CA … SM6T75CA
	SMBJxxA-TR		SMBJ5.0A-TR…SMBJ70A-TR
	SMBJxxCA-TR		SMBJ5.0CA-TR…SMBJ70CA-TR
	SMLVT3V3		n/a
	SMP80-xxx		n/a
	SMP100-xxx		n/a
	SMTPAxxx		n/a
SMC	LNBTVSxxxS		n/a
	SMCJxxA-TR		n/a
	SMCJxxCA-TR		n/a
	SM15TxxxA		n/a
	SM15TxxxCA		n/a
	SM5908		n/a
STmite	SM2Txxx		n/a
	SMTYxxx		n/a

Specific devices not expressly listed in the above table are included in the announced change.

WHAT IS THE CHANGE?

The **ECOPACK®2** grade is defined as follows:

1. **RoHS compliant**, including with exemptions,
2. **500 ppm** maximum of **Antimony** as oxide or organic compound in each organic assembly materials (glue, substrate, mold compounds, housing).
3. **900ppm** maximum of [Bromine + Chlorine], this value referring to the maximum total content.

The use of a so-called **“Halogen-free”** moulding compound will have **no impact** on the **dimensional, thermal** and intrinsic **electrical parameters of the products** with reference to the product datasheet. This was verified by the qualification program.

For the **Transils** with voltage **inferior to 100V** in **SMA and SMB packages**, the **dice design has been optimized** to take benefit of our last technology developments and design innovations. The **related datasheets** have been updated accordingly as indicated below.

Parameter (SMAJ, SM6T, SMBJ)	Current specification	New specification
Leakage current (> 10V V_{RM}, at 25°C)	< 800nA	< 200nA
Leakage current (> 10V V_{RM}, at 85°C)	Not specified	< 1µA
ESD compliance versus IEC 61000-4-2	Not specified	15kV contact
Dynamic Resistance	Not specified	Specified
Power derating curve above 25°C	No derating up to 25°C	400W no derating up to 65°C 600W no derating up to 120°C

Both changes will be **simultaneously implemented** in the manufacturing sites of **Morocco** and **China**.

There is **no change** in the **packing mode** and in the standard **delivery quantities**.

HOW AND WHEN?

Qualification program and results availability:

The **qualification program** for each change described above mainly consists of **reliability tests** and **comparative electrical characterizations**.

Those **qualification reports** are annexed to this document.

Samples and characterization data availability:

Qualification samples of selected devices are **available** on request.

Other samples are available on request for delivery within notice period if ordered within 30 days from notification.

Change implementation schedule:

The **production change** and **first shipments** will be implemented according to our work in progress and materials availability as indicated in the schedule below:

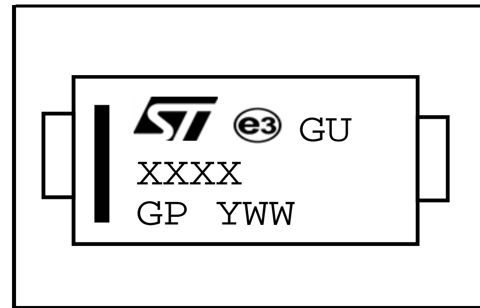
Production Start	1st Shipments
From Week 35-2009	From Week 47-2009

Following Jedec Standard No. 46-C, lack of acknowledgement of the PCN within **30 days** will constitute acceptance of the change. After acknowledgement, lack of additional response within the **90 days** from PCN notification period will constitute acceptance of the change (*). In any case, **first shipments** may start earlier with customer’s **written agreement**.

(*) Unless otherwise specified in a customer specific agreement.

Marking and traceability:

When there is room enough on the body of the package, the **marking** of the modified components will be differentiated with an **additional letter "G" that will be printed to the right of the "e3"** symbol specified by IPC-JEDEC J-STD 609 standard (see drawing beside).



The **traceability** for the modified products will be ensured by an **internal codification** and by the **Q.A. number**.

Conversion roadmap:

Deliveries of **current product versions** will continue while the conversion is brought to completion and as long as stocks last.

Annex: Related qualification reports

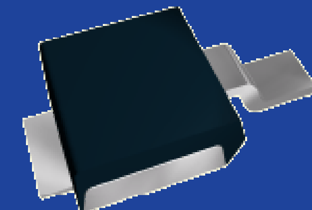
- **07032QRP**: Protection devices in STmite package, conversion to halogen-free
- **08198QRP**: Protection devices in SMA/SMB/SMC packages assembled in Morocco, conversion to halogen-free
- **08217QRP**: Protection devices in SMA/SMB/SMC packages assembled in China, conversion to halogen-free
- **09182QRP**: Transils in SMA/B with voltage < 100V, die design optimization.

QUALIFICATION REPORT

Protection devices and Rectifiers in STmite package:
Conversion to halogen-free moulding compound

Author : Didier PELTIER
Quality Assurance ST TOURS

Ref:07032QRP Rev:A
Date: 23-FEB-2007



Protection devices and Rectifiers in STmite package: Conversion to halogen-free moulding compound

REVISION TRACKING

Revision	Date	Description of revision	Name
A	23-Feb-2007	Creation	D.P

Protection devices and Rectifiers in STmite package: Conversion to halogen-free moulding compound

CONTENTS

- What is the change

- Product range.

- Basics of die technology.

- Basics of package technology.

- QC process flow chart.

- Qualification plan : Guidelines and description / Reliability tests selection.

- Reliability evaluation : Tests conditions / Results.

- Average Outgoing Quality level.

- Assessment.

Protection devices and Rectifiers in STmite package: Conversion to halogen-free moulding compound

WHY THIS CHANGE? / WHAT IS THE CHANGE?

Refer to Product Notice Change IMS-DIS/06/STM

Why this change?

In order to meet the global market trend aiming at restricting the Brominated, Chlorinated and Antimony Trioxide based flame retardants, ST announces the conversion of its STmite package epoxy moulding compound to halogen-free.
Such material is considered halogen-free when the concentration of Brominated compound, Chlorinated compound and Sb_2O_3 are each inferior to 1000 ppm of the plastic weight of the component.

What is the change?

The current epoxy moulding compound EME1100H of Sumitomo will be replaced by the Hysol GR360A, with no other change in the assembly Bill Of Material of the components.
Same test and assembly process will continue to be implemented, with no impact on the mechanical, thermal and electrical parameters of the products with reference to the product datasheets. This was verified in the qualification program.
The product marking will be maintained identical with no change with respect to the compliance with the RoHS* directive. There will be no change in the MSL (moisture sensitivity level 1), packing mode and the standard delivery quantitiy.

Protection devices and Rectifiers in STmite package: Conversion to halogen-free moulding compound

PRODUCT RANGE

Product	Description	Leakage current	Breakdown voltage	Clamping voltage
SM2T3V3A SM2T6V8A SM2T14A SM2T18A SM2T27A	Transil™ STD 200W unidirectional	Ir < 500µA @ 3.3V Ir < 50µA @ 5V Ir < 1µA @ 12V Ir < 1µA @ 16V Ir < 1µA @ 24V	Vbr > 3.6V @ 1mA Vbr > 6.4V @ 1mA Vbr > 13.3V @ 1mA Vbr > 17.1V @ 1mA Vbr > 25.7V @ 1mA	Vcl < 6.8V @ IPP=30A Vcl < 9.2V @ IPP=19.6A Vcl < 19.9V @ IPP=9A Vcl < 26V @ IPP=7A Vcl < 28.9V @ IPP=4.6A

Product	Description	Leakage current	Forward voltage	Clamping voltage
SMTY18AM	Transky™	4mA @ 16V	Vf < 0.48V @ 0.85A	Vcl < 20V @ IPP=1A

Product	Description	Leakage current	Forward voltage
STPS0520M	Power Schottky 0.5A	Ir < 50µA @ 20V	Vf < 0.385V @ 0.5A
STPS1150M STPS120M STPS1L20M STPS1L30M STPS1L40M	Power Schottky 1A	Ir < 1µA @ 150V Ir < 3.9µA @ 20V Ir < 1µA @ 20V Ir < 1µA @ 30V Ir < 1µA @ 40V	Vf < 0.82V @ 1A Vf < 0.49V @ 1A Vf < 0.37V @ 1A Vf < 0.34V @ 1A Vf < 0.40V @ 1A

Protection devices and Rectifiers in STmite package: Conversion to halogen-free moulding compound

BASICS OF DIE TECHNOLOGY

Part number	Wafer diameter	Die tech.	Die metallisation (front side)	Die metallisation (back side)
SM2T3V3A	6 inches	Planar	Ti / Tw /Al /Ni /Au	Ti / Ni /Au
SM2T6V8A			Al / Ni / Au	Al / Ni / Au
SM2T14A			Al / Ni / Au	Al / Ni / Au
SM2T18A			Al /Ti /Ni /Au	Al / Ni / Au
SM2T27A			Al / Ni / Au	Al / Ni / Au
SMTY18AM			Ti / Tw /Al /Ni /Au	Ti / Ni / Au
STPS0520M STPS1150M STPS120M STPS1L20M STPS1L30M STPS1L40M	5 inches		Al / Ni / Au	Ti / Ni / Au

DIE / DIFFUSION PLANTS LOCATIONS :
STmicroelectronics TOURS (FRANCE) / STmicroelectronics Ang Mo Kio (SINGAPORE)

BASICS OF PACKAGE TECHNOLOGY

ASSEMBLY DESCRIPTION

Part number	Package	Die attach material	Wire bonding material	Frame material	Lead finish material	Molding compound (*)
SM2T3V3A SM2T6V8A SM2T14A SM2T18A SM2T27A SMTY18AM STPS0520M STPS1150M STPS120M STPS1L20M STPS1L30M STPS1L40M	STmite (JEDEC: DO-216AA)	Soft solder	Bridge (No wire)	Copper	Matte Sn (Lead free)	Epoxy resin GR360A

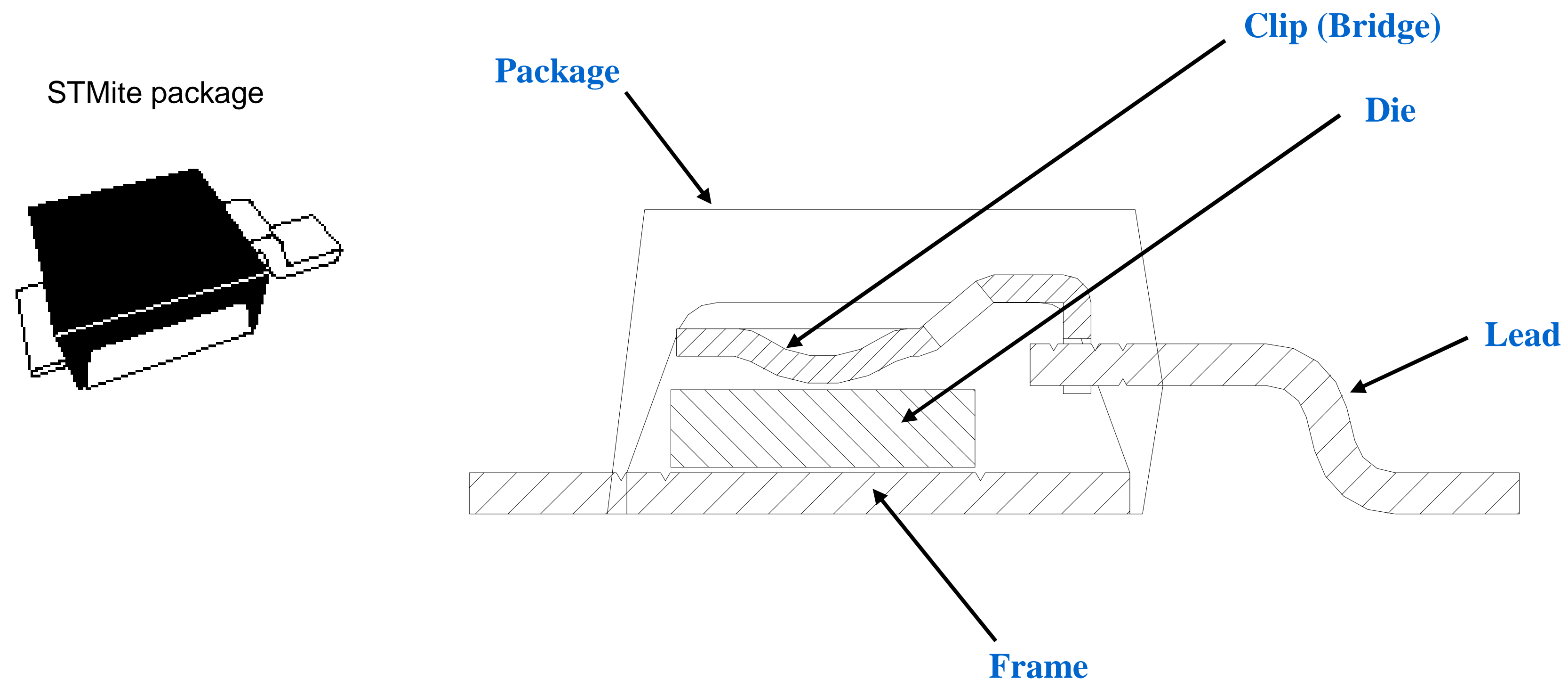
(*): epoxy resin flammability is rated UL94V0

ASSEMBLY / TEST PLANT LOCATION : Subcontractor in China

Protection devices and Rectifiers in STmite package: Conversion to halogen-free moulding compound

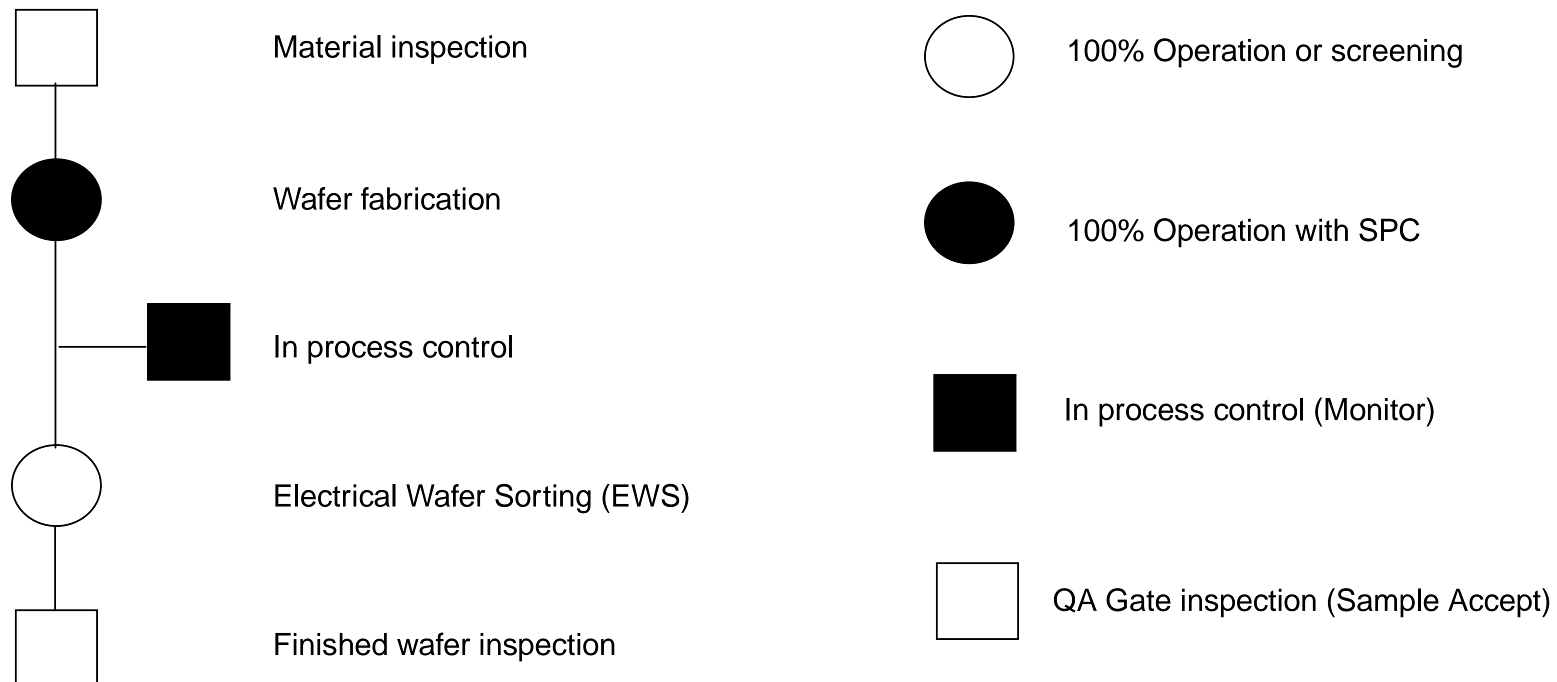
BASICS OF PACKAGE TECHNOLOGY

INNER ASSEMBLY STRUCTURE



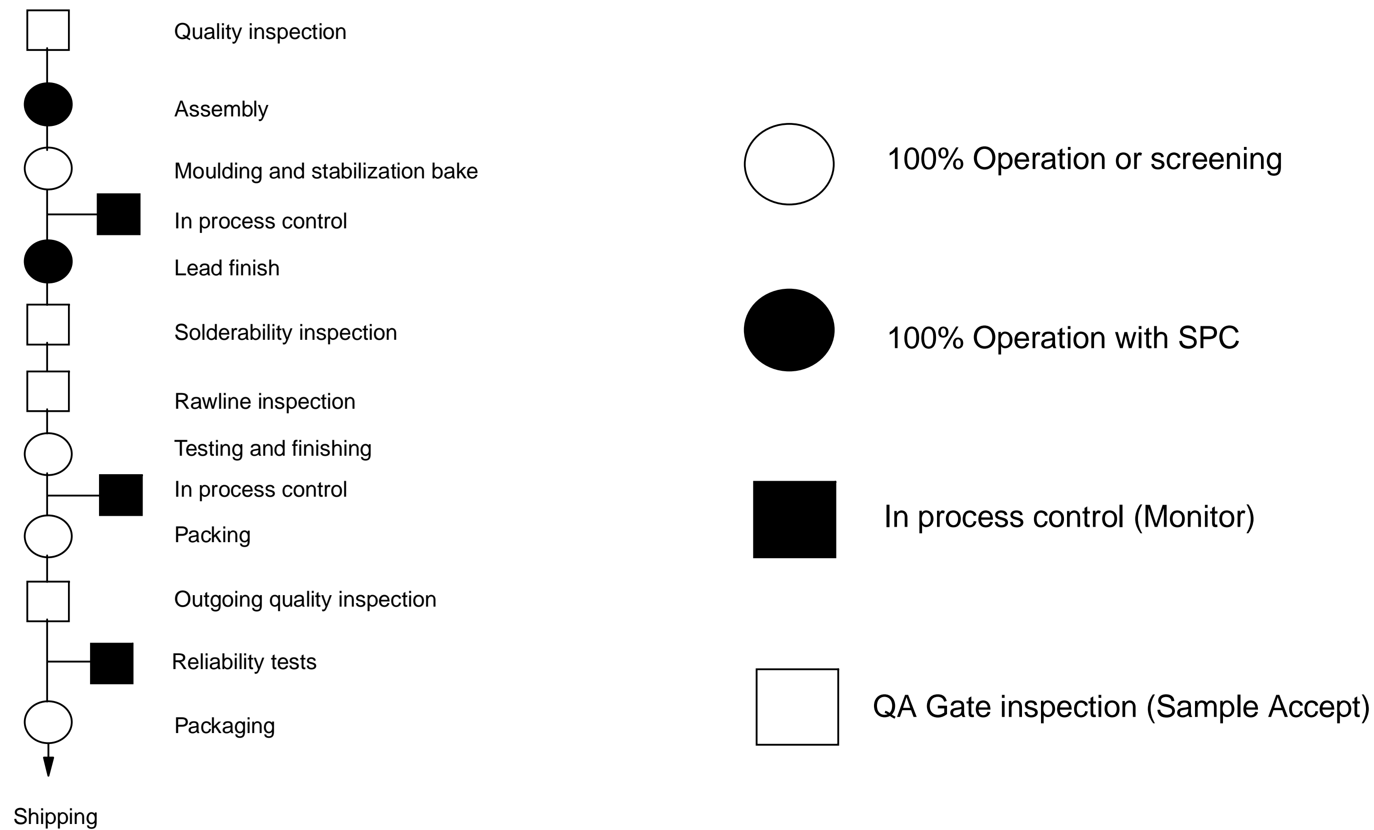
QC PROCESS FRONT END FLOW CHART

Wafer Fab standard production process flow chart



Protection devices and Rectifiers in STmite package: Conversion to halogen-free moulding compound

QC PROCESS BACK END FLOW CHART



QUALIFICATION PLAN : GUIDELINES AND DESCRIPTION

* Applicable documents : general procedure SOP2610 (STMicroelectronics).
  Detail specification : 7923852 (STMicroelectronics).

* Guidelines : a product or a family of products is considered qualified when it fullfils the requirements of a qualification plan which covers various aspects such as : development, reliability and manufacturing.

RELIABILITY EVALUATION : TEST SELECTION GUIDELINES

Specific emphasis is put on electrical, thermo mechanical and environmental tests which are intended to accelerate failure mechanisms in order to define the limits of the products when they are submitted to industrial conditions.

The tests performed are split into 2 main families called die oriented tests and package oriented tests.
Tests are selected according to the knowledge of application conditions of the products, failure mode effect analysis performed at design / development, and to the history of the manufacturing process.

The attached sheets provide relevant information on applicable tests, international standards, failure point, failure process, sample size as well as acceptance numbers.

RELIABILITY : ABBREVIATIONS AND MEANINGS

* Failure point	: Physical localization of failure.
* Failure process	: Physical or chemical or other mechanism resulting in a failure.
* F I T	: Failure unit ; 1 fit = 1 failure in 10^9 devices - Hours.
* Failure rate	: Also called "Lambda - λ" ; it is the incremental change in the number of failures per associated incremental change with time. The failure rate is expressed in fits. Note : MTBF (Mean Time Between Failure) = $1/\lambda$. Currently "λ" is provided in the life-time of the device (constant λ ; exponential modelisation of the population reliability : $R(t) = \frac{N(t)}{N(to)} = e^{-\lambda t}$)
* Accelerating factor	:The physical or chemical factor increasing the failure rate.
•Confidence level	: A 60% confidence level means there is a 60% possibility that the sample came from a population whose failure rate does not exceed the given failure rate.
* Ea	: Activation energy (eV : electron volt). Activation energy is introduced Arrhenius law It is representative of the failure mechanism involved. Ex : 1eV is used to modelize failure rate when surface charges are involved.

Protection devices and Rectifiers in STmite package: Conversion to halogen-free moulding compound

RELIABILITY : DIE ORIENTED TESTS

TEST DESCRIPTIONS	FAILURE POINT	FAILURE PROCESS	ACCELERATING FACTORS / ACTIV. ENERGY
PRECONDITIONING (JESD22A-113) - 24hrs / 125°C - 168hrs / 85%RH / 85°C - 3 IR reflow (260°C max)	PACKAGE HERMETICITY AND DIE VOLUME	POOR HERMETICITY SILICON / PACKAGE	TEMPERATURE AND HUMIDITY SOLDERING SIMULATION
HIGH TEMPERATURE REVERSE BIAS (HTRB) JESD22A-108 1000Hrs, Tj max, VRRM	PASSIVATION LAYERS	SURFACE CHARGES ACCUMULATION	TEMPERATURE ELECTRICAL FIELD Ea = 1.0 eV
OPERATING LIFE TEST (OLT) MIL STD 750C Tj max as specified ; rated forward voltage ; 1000Hrs	ACTIVE AREA AND MECHANICAL INTERFACES	LOCAL THERMAL RUNAWAY	TEMPERATURE CURRENT DENSITY

Protection devices and Rectifiers in STmite package: Conversion to halogen-free moulding compound

RELIABILITY : PACKAGE ORIENTED TESTS

TEST DESCRIPTIONS	FAILURE POINT	FAILURE PROCESS	ACCELERATING FACTORS / ACTIV. ENERGY
PRECONDITIONING (JESD22A-113) - 24hrs / 125°C - 168hrs / 85%RH / 85°C - 3 IR reflow (260°C max)	PACKAGE HERMETICITY AND DIE VOLUME	POOR HERMETICITY SILICON / PACKAGE	TEMPERATURE AND HUMIDITY SOLDERING SIMULATION
THERMAL CYCLING (TCT) JESD22A-104 -55°C/+150°C ; Air / Air ; 1000Cycles	DIE VOLUME DIE ATTACH INTERFACE PASSIVATION LAYERS	SILICON / PACKAGE THERMAL EXPANSION COEFFICIENT MISMATCH	T EXTREMES IN CYCLING.
AUTOCLAVE TEST (PCT) JESD22A-102 133°C ; 3Atm ; 100% RH ; 67Hrs	DIE PERIPHERY PASSIVATION	POOR HERMETICITY CONTAMINATION	TEMPERATURE / PRESSURE
HUMIDITY BIAS (THB) JESD22A-101 85°C 85%RH ; 1000Hrs ; Vbias = Vrm (100V max)	DIE PERIPHERY PASSIVATION BONDS METALLISATION	POOR HERMETICITY CONTAMINATION CORROSION	HUMIDITY TEMPERATURE VOLTAGE Ea=0.8eV
SOLDERABILITY J-STD-002	LEAD SURFACE	PLATING OR DIPPING PROCESS MATERIAL	AGING HUMIDITY TEMPERATURE
RESISTANCE TO SOLDER HEAT 2 oil dipping 260°C 10s ON / 15s OFF	DIE VOLUME	SILICON / PACKAGE	SOLDERING SIMULATION

Protection devices and Rectifiers in STmite package: Conversion to halogen-free moulding compound

RELIABILITY : DIE ORIENTED TESTS CONDITIONS / RESULTS

RELIABILITY TEST	TEST CONDITIONS	RUNNER	RESULTS	EXAMPLE OF DRIFT ANALYSIS
HIGH TEMPERATURE REVERSE BIAS (HTRB) After preconditioning JESD22A-108	Tj=150°C, 1000hrs, VR = 0.8 x Vrm	Rectifier diode in SMD package Resin: GR360A Vrm= 1000V	0 / 77	-
OPERATING LIFE TEST (OLT)	Tj, If as per the datasheet, 1000hrs	STPS1150M	0 / 77	Refer to graphs #1 and #2
		Rectifier diode in SMD package Resin: GR360A If= 1A	0 / 77	-

PRECONDITIONING according to JESD22A-113
- 24hrs / 125°C
- 168hrs / 85%RH / 85°C
- 3 IR reflow in oven with recommended T° profile

Note : failure criteria : electrical parameter as defined in product data sheet
(*) selected as per structural similarities procedures for CECC 90000 - Issue 4 - Para 3.2.

Protection devices and Rectifiers in STmite package: Conversion to halogen-free moulding compound

RELIABILITY : PACKAGE ORIENTED TESTS CONDITIONS / RESULTS

RELIABILITY TEST	TEST CONDITIONS	RUNNER	RESULTS	EXAMPLE OF DRIFT ANALYSIS
PRECONDITIONING + THERMAL CYCLING (TCT) JESD22A-104	-55°C/+150°C, 1000cycles	SM2T18A	0 / 77	-
		Rectifier diode in SMD package Resin: GR360A	0 / 77	-
PRECONDITIONING + AUTOCLAVE TEST (PCT) JESD22A-102	121°C, 2bars, 96hrs	SM2T18A STPS1150M	0 / 77 0 / 77	Graphs #3 & #4 Graphs #5 & #6
		Rectifier diode in SMD package Resin: GR360A	0 / 77	-
PRECONDITIONING + HUMIDITY BIAS (THB) JESD22A-101	85°C 85%RH ; V=Vrm (100V max) 1000Hrs	SM2T18A	0 / 77	-
		Protection diode in SMD package Resin: GR360A Vrm=33.3V	0 / 77	-
		Rectifier diode in SMD package Resin: GR360A Vrm= 600V	0 / 77	-

PRECONDITIONING according to JESD22A-113
- 24hrs / 125°C
- 168hrs / 85%RH / 85°C
- 3 IR reflow in oven with recommended T° profile (260°C Max)

Note : failure criteria :electrical parameter as defined in product data sheet

Protection devices and Rectifiers in STmite package: Conversion to halogen-free moulding compound

RELIABILITY : PACKAGE ORIENTED TESTS CONDITIONS / RESULTS

RELIABILITY TEST	TEST CONDITIONS	RUNNER	RESULTS
SOLDERABILITY J-STD-002 - Aging A = 16hrs/150°C (dry air) - Aging B = 8hrs/100°C (above boiling water)	Solder bath: Sn/Pb 220°C	SM2T18A	Aging A: 0 / 10 Aging B: 0 / 10
	Solder bath: Sn /Ag/Cu 245°C	STPS1150M	Aging A: 0 / 10 Aging B: 0 / 10
RESISTANCE TO SOLDER HEAT (RSH) JESD22B-106-A	2 oil dipping 260°C 10s ON / 15s OFF	SM2T18A STPS1150M	0 / 30 0 / 30
		Protection diode in SMD package Resin: GR360A	0 / 30
		Rectifier diode in SMD package Resin: GR360A	0 / 30

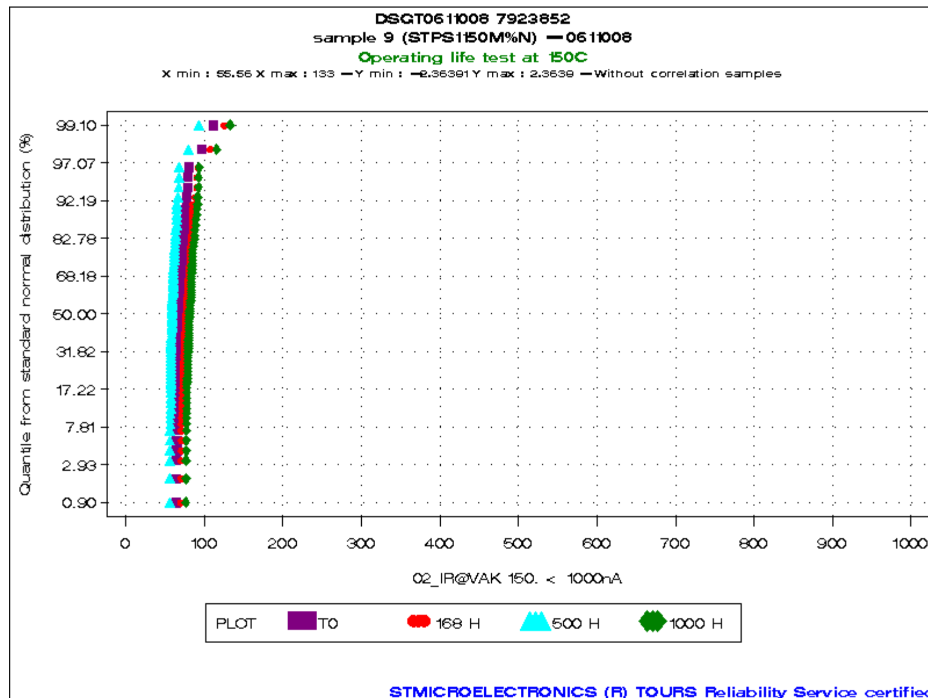
Note : failure criteria :electrical parameter as defined in product data sheet

RELIABILITY DATA : STATISTICS

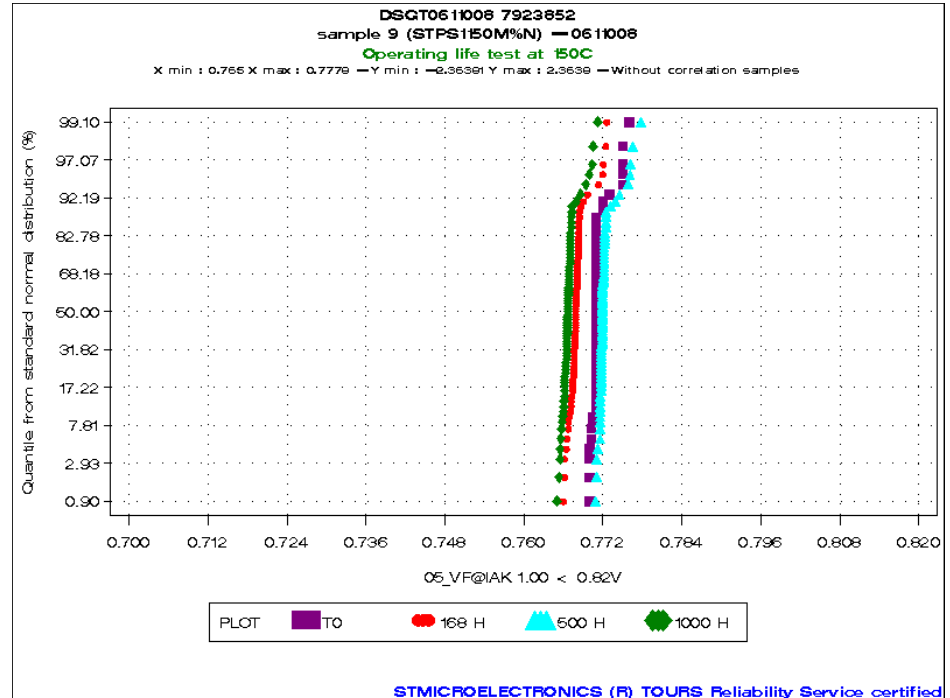
In addition to the above table of results, the following graphs provide a straightforward data analysis with a representation of the selected parameter population in the Henry's chart.
Since the ‘’y ’’ axis represents the cumulative population of the different read-outs, statistical analysis is easy (median, range),
While in addition the overall stability and span during the stress test is immediately evident.

Protection devices and Rectifiers in STmite package: Conversion to halogen-free moulding compound

GRAPHS AND STATISTICS FOR OPERATING LIFE TEST (OLT)



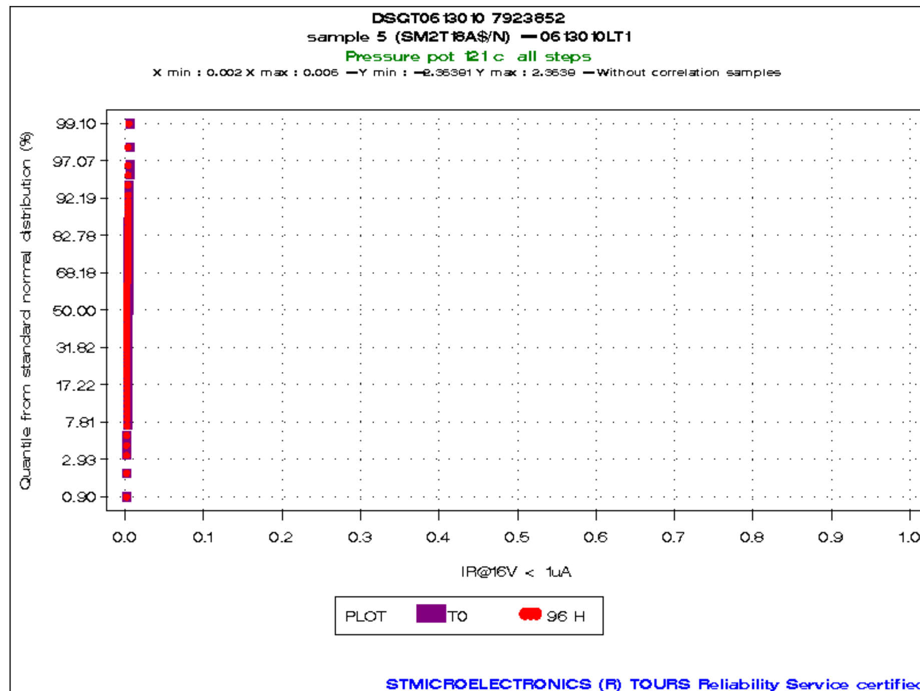
Graph #1 : IR : leakage current



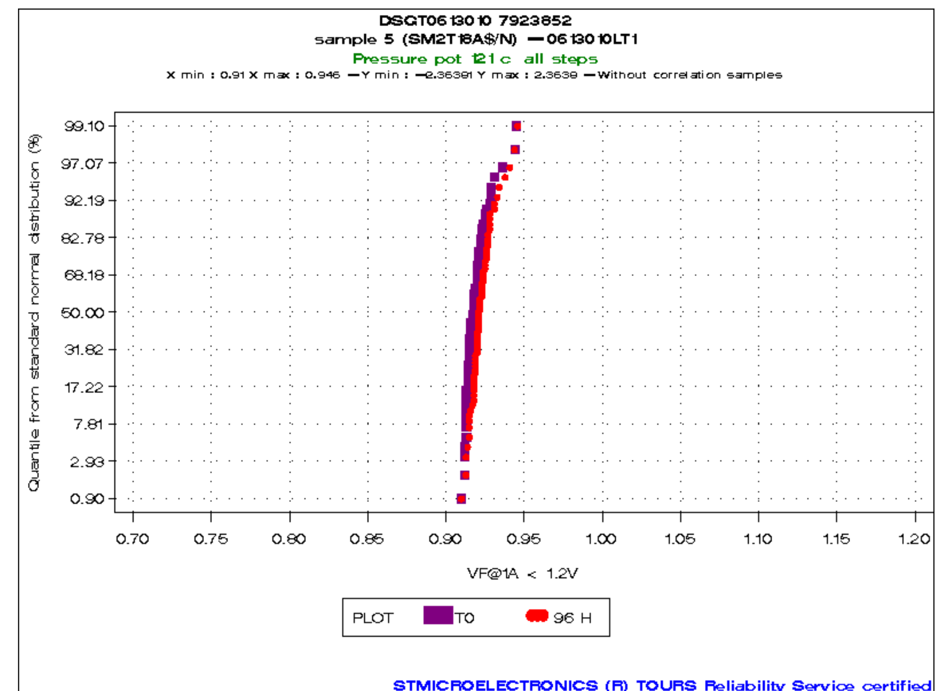
Graph #2 : VF : Forward voltage

Protection devices and Rectifiers in STmite package: Conversion to halogen-free moulding compound

GRAPHS AND STATISTICS FOR PCT



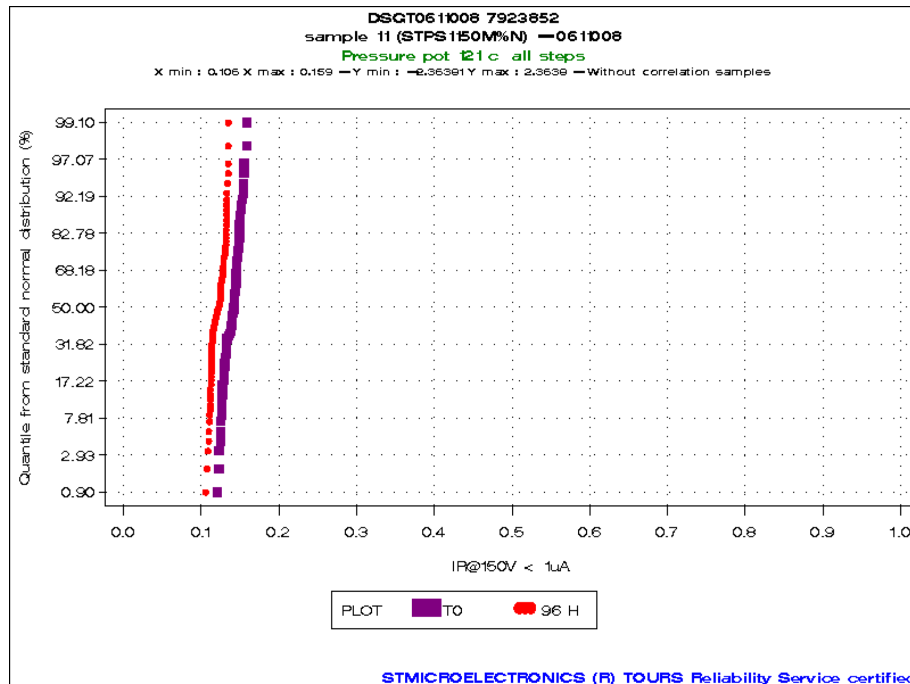
Graph #3 : IR : leakage current



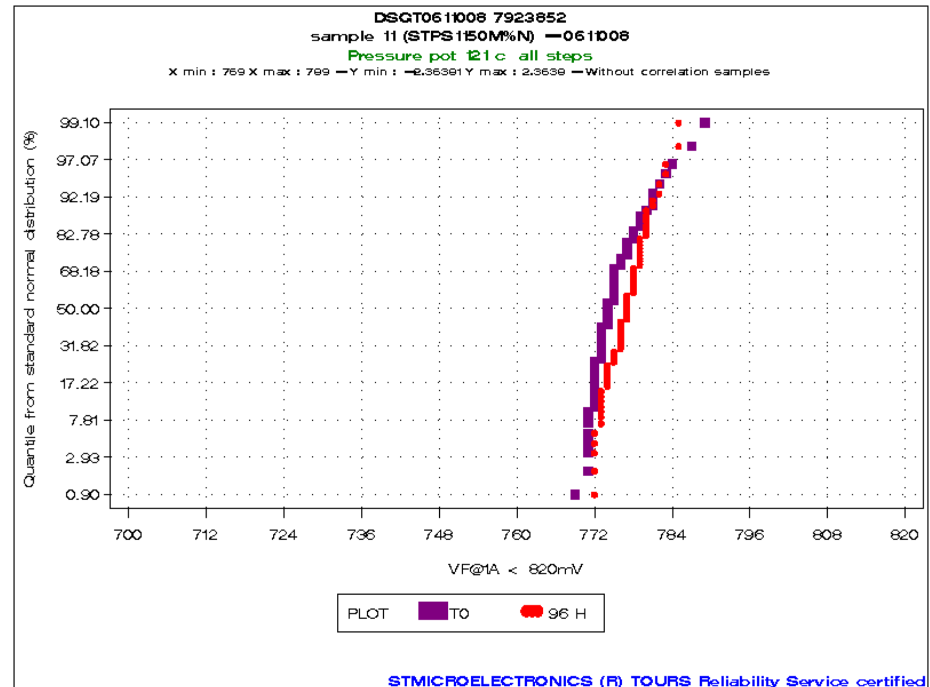
Graph #4 : VF : Forward voltage

Protection devices and Rectifiers in STmite package: Conversion to halogen-free moulding compound

GRAPHS AND STATISTICS FOR PCT



Graph #5 : IR : leakage current



Graph #6 : VF : Forward voltage

AVERAGE OUTGOING QUALITY LEVEL AT FINAL GATE

Sampling plans at Final quality inspection prior to shipment:

- 200 units per lot for electrical inspection. Acceptance criteria = 0/1
- 315 units per lot for visual and mechanical inspection. Acceptance criteria = 0/1

Ppm calculation:

$$\textbf{Average Output Quality Estimator} = \frac{\text{Total number of defectives on samples with } d \leq (c+1)}{\text{Total number of inspected units in accepted lots}} \times 10^6$$

where d = defectives on sample
c = acceptance criteria

PARAMETER INSPECTED	INSPECTION LEVEL	AQL
VISUAL and MECHANICAL	II	0.04%
ELECTRICAL	II	0.065%

Protection devices and Rectifiers in STmite package: Conversion to halogen-free moulding compound

ASSESSMENT

Qualification plan requirements have been fulfilled without exception.
It is stressed that reliability tests have shown that the devices behave correctly against environmental tests (no failure). Moreover, the stability of electrical parameters during the accelerated tests demonstrates the ruggedness of the products and safe operation, which is consequently expected during their life-time.

Completion date	Location	Department	Name
23-FEB-2007	STMicroelectronics Rue Pierre et Marie CURIE BP155 37071 TOURS Cedex 2, FRANCE	Product Quality Assurance	Didier PELTIER Quality Assurance E-mail : didier.peltier@st.com

QUALIFICATION REPORT

SMA / SMB /SMC packages in new Halogen-Free Molding Compound *Assembly location: Morocco*

Author : Didier PELTIER
IMS – ASD&IPAD Division
Quality Assurance ST Tours

Ref: 08198QRP Rev: C
Date: 20-July-09

SMA / SMB / SMC package in new Halogen-Free Molding Compound
Assembly location: Morocco

REVISION TRACKING

Revision	Date	Description of revision	Name
A	22-Aug-08	Creation	DP
B	24-Feb-09	Add SMA package	DP
C	20-July-09	Add SMC package	DP

SMA / SMB / SMC package in new Halogen-Free Molding Compound
Assembly location: Morocco

CONTENTS

- Why this change

- Product range.

- Basics of die technology.

- Basics of package technology.

- QC process flow chart.

- Qualification plan : Guidelines and description / Reliability tests selection.

- Reliability evaluation : Tests conditions / Results.

- Average Outgoing Quality level.

- Assessment.

SMA / SMB / SMC package in new Halogen-Free Molding Compound
Assembly location: Morocco

PRODUCT RANGE

Product family	Series	Package
Protection	SMAJxxx, SMA6Jxxx, SMP30-xxx, SMP50-xxx, SMTYxxx	SMA
	SM6Txxx, SMBJxxx, SMP80xx-xxx, SMP100xx-xxx, SMTPAxxx, SMP75-8	SMB
	SM15Txxx, SMCJxxx, LNBTVSxxx, SM5908	SMC
Rectifier	STPSxxxxU	SMB
	STPSxxxxA	SMA
	STPSxxxxS	SMC
	SMBYxxxx with Vrrm until 400V included	SMB
	SMBYxxxx with Vrrm until 400V included	SMC
	STTHxxxxA with Vrrm until 400V included	SMA
	STTHxxxxU with Vrrm until 400V included	SMB
	STTHxxxxS with Vrrm until 400V included	SMC

BASICS OF DIE TECHNOLOGY

Die / diffusion plant locations:

- ST Microelectronics Tours (France)
- ST Ang Mo Kio (Singapore)

SMA / SMB / SMC package in new Halogen-Free Molding Compound
Assembly location: Morocco

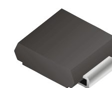
BASICS OF PACKAGE TECHNOLOGY

ASSEMBLY DESCRIPTION

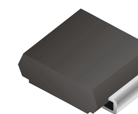
Product family	Die attach material	Bonding material	Frame material	Lead finish material	Package	Molding compound(*)
Protection	Soft solder (Sn/Pb/Ag)	Clip (Copper)	Copper	Sn	SMA SMB SMC	Epoxy resin
Rectifier						

(*): epoxy resin is halogen free and flammability is rated UL94V0

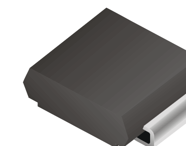
ASSEMBLY / TEST PLANT LOCATION :
STMicroelectronics Bouskoura (MOROCCO)



SMA package



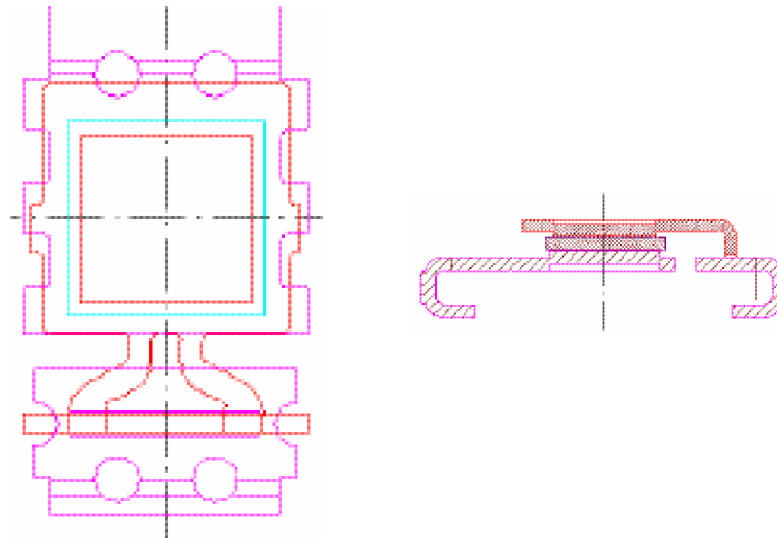
SMB package



SMC package

BASICS OF PACKAGE TECHNOLOGY

INNER ASSEMBLY STRUCTURE FOR SMA,SMB and SMC PACKAGE

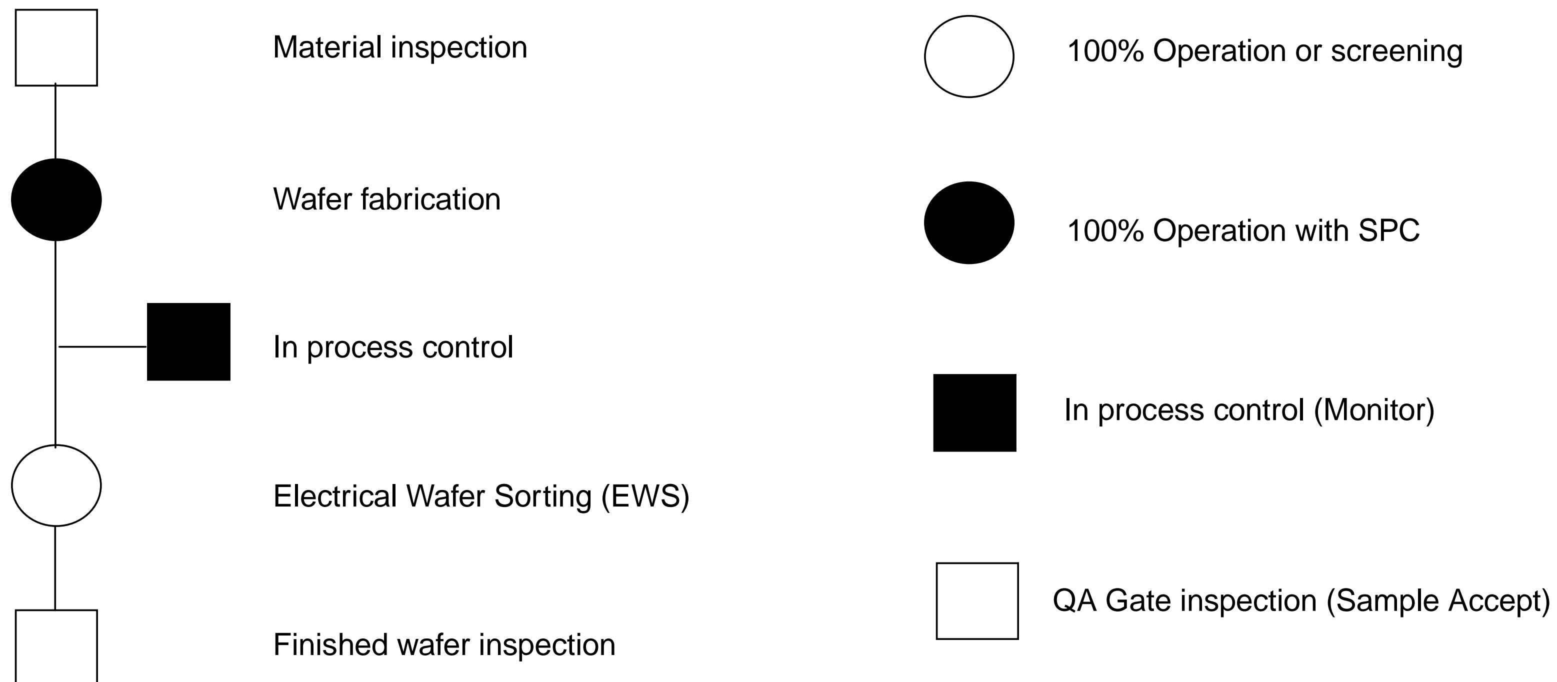


Note: Generic scheme (Die / wire bonding sizes and die design given as example)

SMA / SMB / SMC package in new Halogen-Free Molding Compound
Assembly location: Morocco

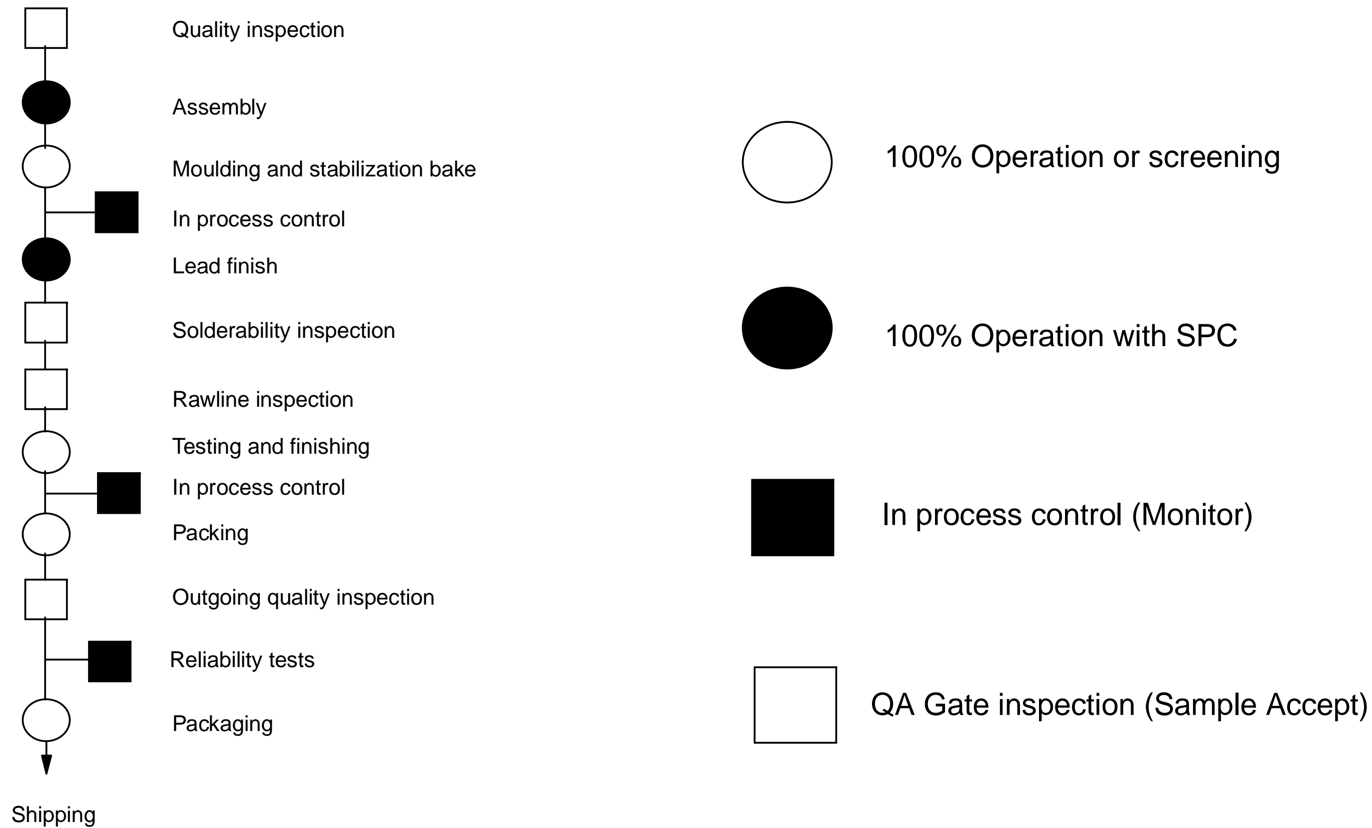
QC PROCESS FRONT END FLOW CHART

Wafer Fab standard production process flow chart



SMA / SMB / SMC package in new Halogen-Free Molding Compound
Assembly location: Morocco

QC PROCESS BACK END FLOW CHART



QUALIFICATION PLAN : GUIDELINES AND DESCRIPTION

* Applicable documents : general procedure SOP2610 (STMicroelectronics).

* Guidelines : a product or a family of products is considered qualified when it fullfils the requirements of a qualification plan which covers various aspects such as : development, reliability and manufacturing.

RELIABILITY EVALUATION : TEST SELECTION GUIDELINES

Specific emphasis is put on electrical, thermo mechanical and environmental tests which are intended to accelerate failure mechanisms in order to define the limits of the products when they are submitted to industrial conditions.

The tests performed are split into 2 main families called die oriented tests and package oriented tests.
Tests are selected according to the knowledge of application conditions of the products, failure mode effect analysis performed at design / development, and to the history of the manufacturing process.

The attached sheets provide relevant information on applicable tests, international standards, failure point, failure process, sample size as well as acceptance numbers.

RELIABILITY : ABBREVIATIONS AND MEANINGS

* Failure point	: Physical localization of failure.
* Failure process	: Physical or chemical or other mechanism resulting in a failure.
* F I T	: Failure unit ; 1 fit = 1 failure in 10^9 devices - Hours.
* Failure rate	: Also called "Lambda - λ" ; it is the incremental change in the number of failures per associated incremental change with time. The failure rate is expressed in fits. Note : MTBF (Mean Time BetweenFailure) = $1/\lambda$. Currently "λ" is provided in the life-time of the device (constant λ ; exponential modelisation of the population reliability : $R(t) = \frac{N(t)}{N(to)} = e^{-\lambda t}$)
* Accelerating factor	:The physical or chemical factor increasing the failure rate.
•Confidence level	: A 60% confidence level means there is a 60% possibility that the sample came from a population whose failure rate does not exceed the given failure rate.
* Ea	: Activation energy (eV : electron volt). Activation energy is introduced in Arrhenius law It is representative of the failure mechanism involved. Ex : 1eV is used to modelize failure rate when surface charges are involved.

SMA / SMB / SMC package in new Halogen-Free Molding Compound
Assembly location: Morocco

RELIABILITY : DIE ORIENTED TESTS

TEST DESCRIPTIONS	FAILURE POINT	FAILURE PROCESS	ACCELERATING FACTORS / ACTIV. ENERGY
HIGH TEMPERATURE REVERSE BIAS (HTRB) JESD22 A-108 For protection, Tj; VR ; 1000Hrs For rectifier: Tj; 0.8xVRRM ; 1000Hrs	PASSIVATION LAYERS	SURFACE CHARGES ACCUMULATION	TEMPERATURE ELECTRICAL FIELD Ea = 1.0 eV
INTERMITENT OPERATING LIFE TEST (IOLT) MIL STD 750C Tj max as specified ; rated forward voltage ; 1000Hrs	ACTIVE AREA AND MECHANICAL INTERFACES	LOCAL THERMAL RUNAWAY	TEMPERATURE CURRENT DENSITY

SMA / SMB / SMC package in new Halogen-Free Molding Compound
Assembly location: Morocco

RELIABILITY : PACKAGE ORIENTED TESTS

TEST DESCRIPTIONS	FAILURE POINT	FAILURE PROCESS	ACCELERATING FACTORS / ACTIV. ENERGY
THERMAL CYCLING (TCT) JESD22 A-104 -65°C/+150°C ; Air / Air ; 1000Cycles	DIE VOLUME DIE ATTACH INTERFACE PASSIVATION LAYERS	SILICON / PACKAGE THERMAL EXPANSION COEFFICIENT MISMATCH	T EXTREMES IN CYCLING.
AUTOCLAVE TEST (PCT) JESD22 A-102 121°C, 2bars, 100%RH, 96hrs	DIE PERIPHERY PASSIVATION	POOR HERMETICITY CONTAMINATION	TEMPERATURE / PRESSURE
TEMPERATURE HUMIDITY BIAS (THB) JESD22 A-101 85°C 85%RH ; device reverse biased at 0.8xVrrm up to a maximum of 100V ; 1000Hrs	DIE PERIPHERY PASSIVATION BONDS METALLISATION	POOR HERMETICITY CONTAMINATION CORROSION	HUMIDITY TEMPERATURE VOLTAGE Ea=0.8eV
SOLDERABILITY J-STD-002 - Dry aging (150°C, 16Hrs) solderability test 220°C / PbSn - Dry aging (150°C, 16Hrs) solderability test 245°C / SnAgCu - Steam aging (100°C, 8Hrs) solderability test 220°C / PbSn - Steam aging (100°C, 8Hrs) solderability test 245°C / SnAgCu	LEAD SURFACE	PLATING OR DIPPING PROCESS MATERIAL	AGING HUMIDITY TEMPERATURE

SMA / SMB / SMC package in new Halogen-Free Molding Compound Assembly location: Morocco

RELIABILITY : DIE ORIENTED TESTS CONDITIONS / RESULTS

RELIABILITY TEST	TEST CONDITIONS	RUNNER(*)	RESULTS	EXAMPLE OF DRIFT ANALYSIS
HIGH TEMPERATURE REVERSE BIAS (HTRB) JESD22 A-108	For Rectifier Tj , V=0.8xVR, 1000hrs For Protection Tj, V=Vr, 1000hrs	SM15T200CA	0 / 77	Page 18
		SMBJ5.0A	0 / 86	-
		STPS340U	0 / 89	Page 19
		STTH112A	0 / 86	-
		SMP100LC-270	0 / 77	-
INTERMITENT OPERATING LIFE TEST (IOLT)	Part powered to reach ΔTj=100°C, 15000 cycles, 2mn ON, 2mn OFF	STPS340U	0 / 86	-
		STTH112A	0 / 86	Page 20

Note 1: *failure criteria :electrical parameter as defined in product data sheet.*

(*) selected as per structural similarities procedures for AEC-Q101 standard

SMA / SMB / SMC package in new Halogen-Free Molding Compound
Assembly location: Morocco

RELIABILITY : PACKAGE ORIENTED TESTS CONDITIONS / RESULTS

RELIABILITY TEST	TEST CONDITIONS	RUNNER(*)	RESULTS	EXAMPLE OF DRIFT ANALYSIS
THERMAL CYCLING (TCT) JESD22 A-104	-65°C/+150°C, 1000cycles	SM15T200CA	0 / 31	-
		SMBJ5.0A	0 / 77	-
		STPS340U	0 / 77	Page 21& page 22
		STTH112A	0 / 78	-
AUTOCLAVE TEST (PCT) JESD22 A-102	121°C, 2bars, 100%RH, 96hrs	SM15T200CA	0 / 74	-
		SMBJ5.0A	0 / 77	Page 23
		STPS340U	0 / 77	-
		STTH112A	0 / 79	-

Note 1: *failure criteria :electrical parameter as defined in product data sheet.*
Note 2: *All surface mount devices (SMD's) submitted to pre-conditionning prior reliability test as per JEDEC JESD22-A113.*
(*) selected as per structural similarities procedures for AEC-Q101 standard

SMA / SMB / SMC package in new Halogen-Free Molding Compound
Assembly location: Morocco

RELIABILITY : PACKAGE ORIENTED TESTS CONDITIONS / RESULTS

RELIABILITY TEST	TEST CONDITIONS	RUNNER(*)	RESULTS	EXAMPLE OF DRIFT ANALYSIS
TEMPERATURE HUMIDITY BIAS (THB) JESD22 A-101	85°C 85%RH; V=0.8xVR (<100V); 1000Hrs	SM15T200CA	0 / 80	Page 24
		SMBJ5.0A	0 / 77	-
		STPS340U	0 / 77	Page 25
		STTH112A	0 / 80	-

Note 1: *failure criteria :electrical parameter as defined in product data sheet.*
Note 2: *All surface mount devices (SMD's) submitted to pre-conditionning prior reliability test as per JEDEC JESD22-A113.*
(*) selected as per structural similarities procedures for AEC-Q101 standard.

SMA / SMB / SMC package in new Halogen-Free Molding Compound
Assembly location: Morocco

RELIABILITY : PACKAGE ORIENTED TESTS CONDITIONS / RESULTS

RELIABILITY TEST	TEST CONDITIONS	RUNNER(*)	RESULTS
SOLDERABILITY J-STD-002	- Dry aging (150°C, 16Hrs) solderability test 220°C / PbSn - Dry aging (150°C, 16Hrs) solderability test 245°C / SnAgCu - Steam aging (100°C, 8Hrs) solderability test 220°C / PbSn - Steam aging (100°C, 8Hrs) solderability test 245°C / SnAgCu	SM15T200A	0 / 40 (10 units per test cond.)
		SMAJ188CA	0 / 40 (10 units per test cond.)
		SMBJ5.0A	0 / 40 (10 units per test cond.)
		STPS340U	0 / 40 (10 units per test cond.)
		STTH112A	0 / 40 (10 units per test cond.)
IR REFLOW J-STD-020C	3 time with IR Reflow 260°C max (lead free profile)	STPS340U	0 / 500
		STTH112A	0 / 500
		SMBJ5.0A	0 / 500

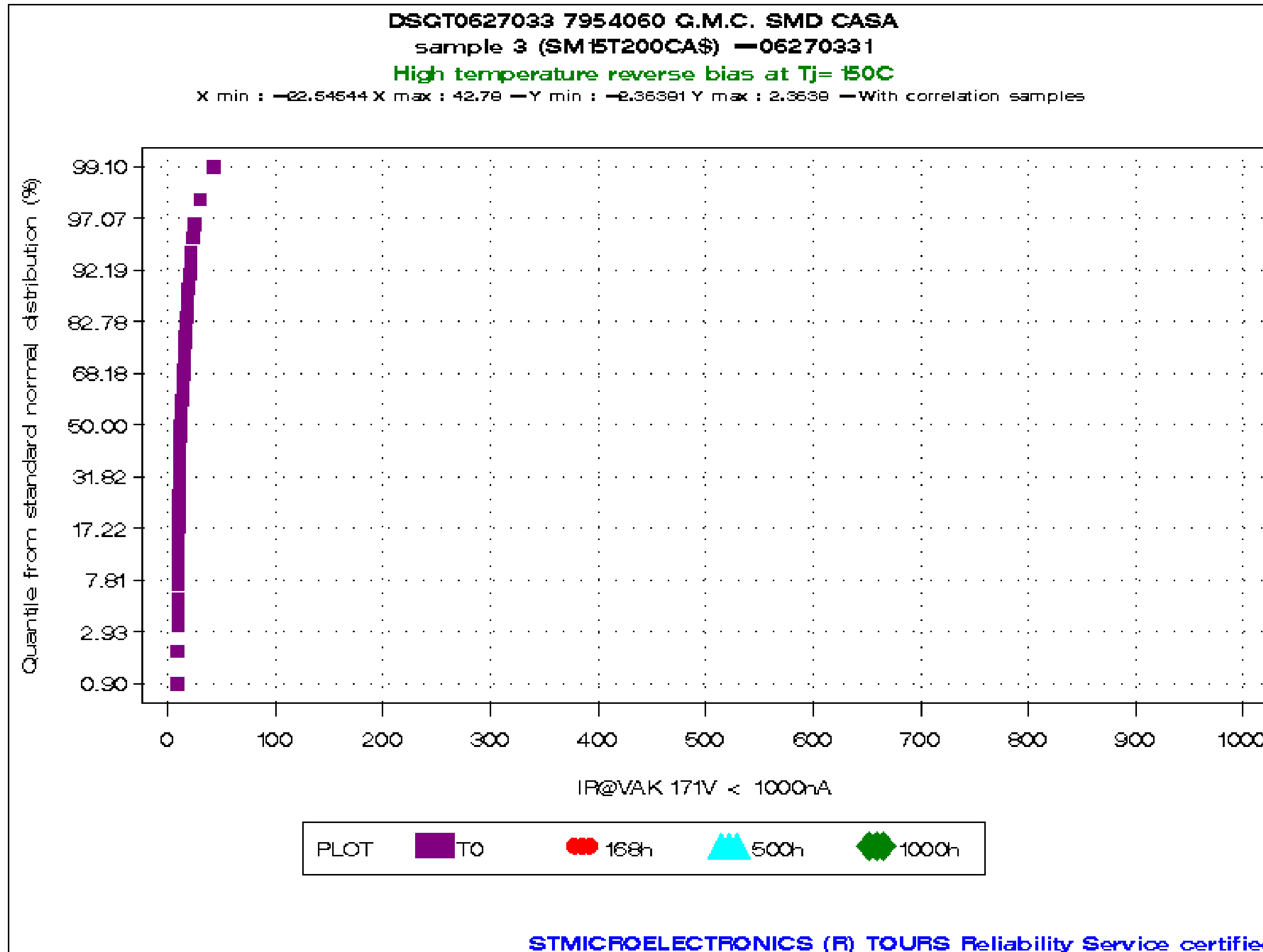
Note 1: *failure criteria :electrical parameter as defined in product data sheet.*
Note 2: *All surface mount devices (SMD's) submitted to pre-conditionning prior reliability test as per JEDEC JESD22-A113.*
(*) selected as per structural similarities procedures for AEC-Q101 standard

RELIABILITY DATA : STATISTICS

In addition to the above table of results, the following graphs provide a straightforward data analysis with a representation of the selected parameter population in the Henry's chart.
Since the « y » axis represents the cumulative population of the different read-outs, statistical analysis is easy (median, range), while the overall stability and span during the stress test is immediately evident.

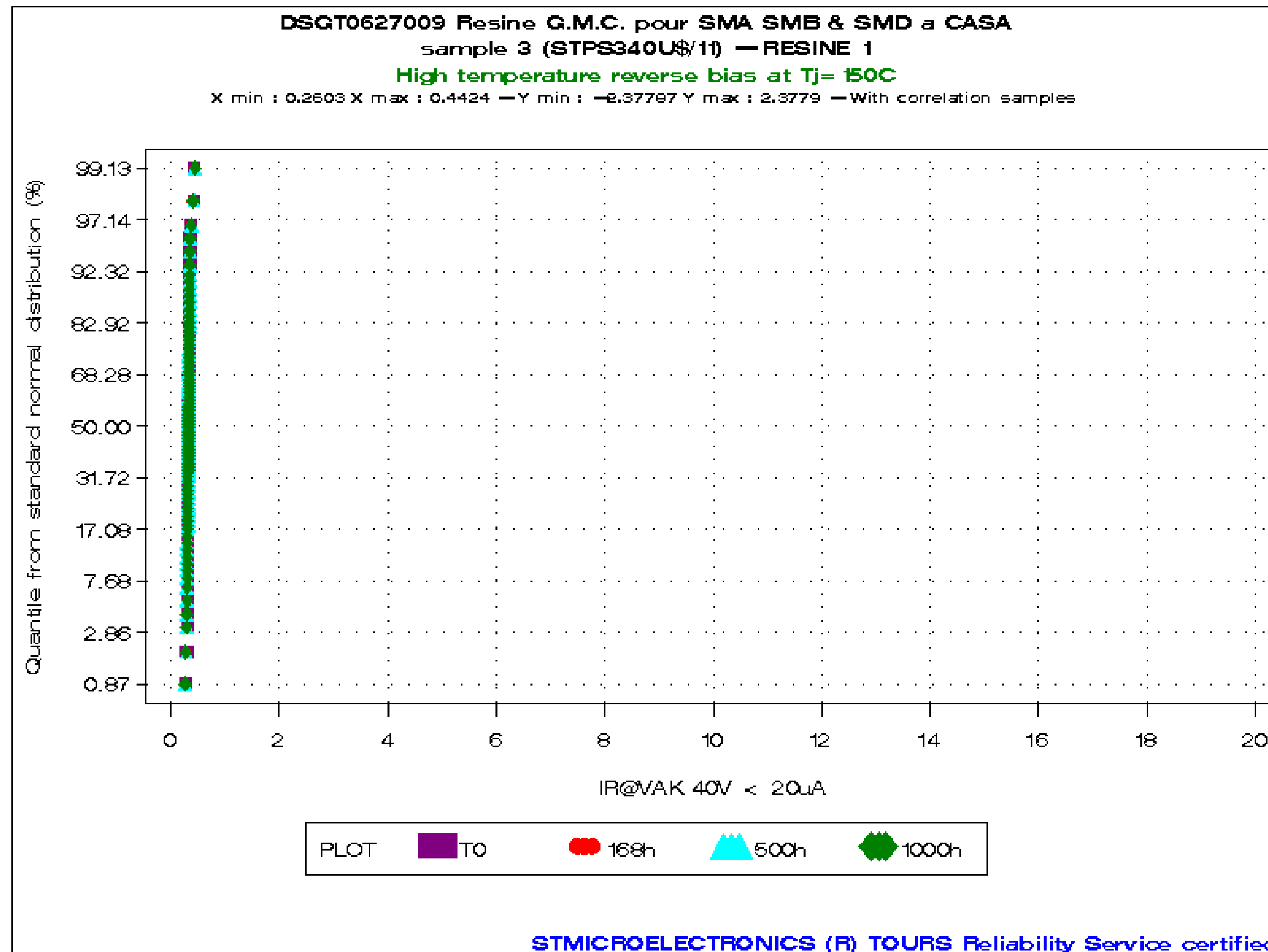
SMA / SMB / SMC package in new Halogen-Free Molding Compound
Assembly location: Morocco

GRAPHS AND STATISTICS FOR HIGH TEMPERATURE REVERSE BIAS (HTRB)



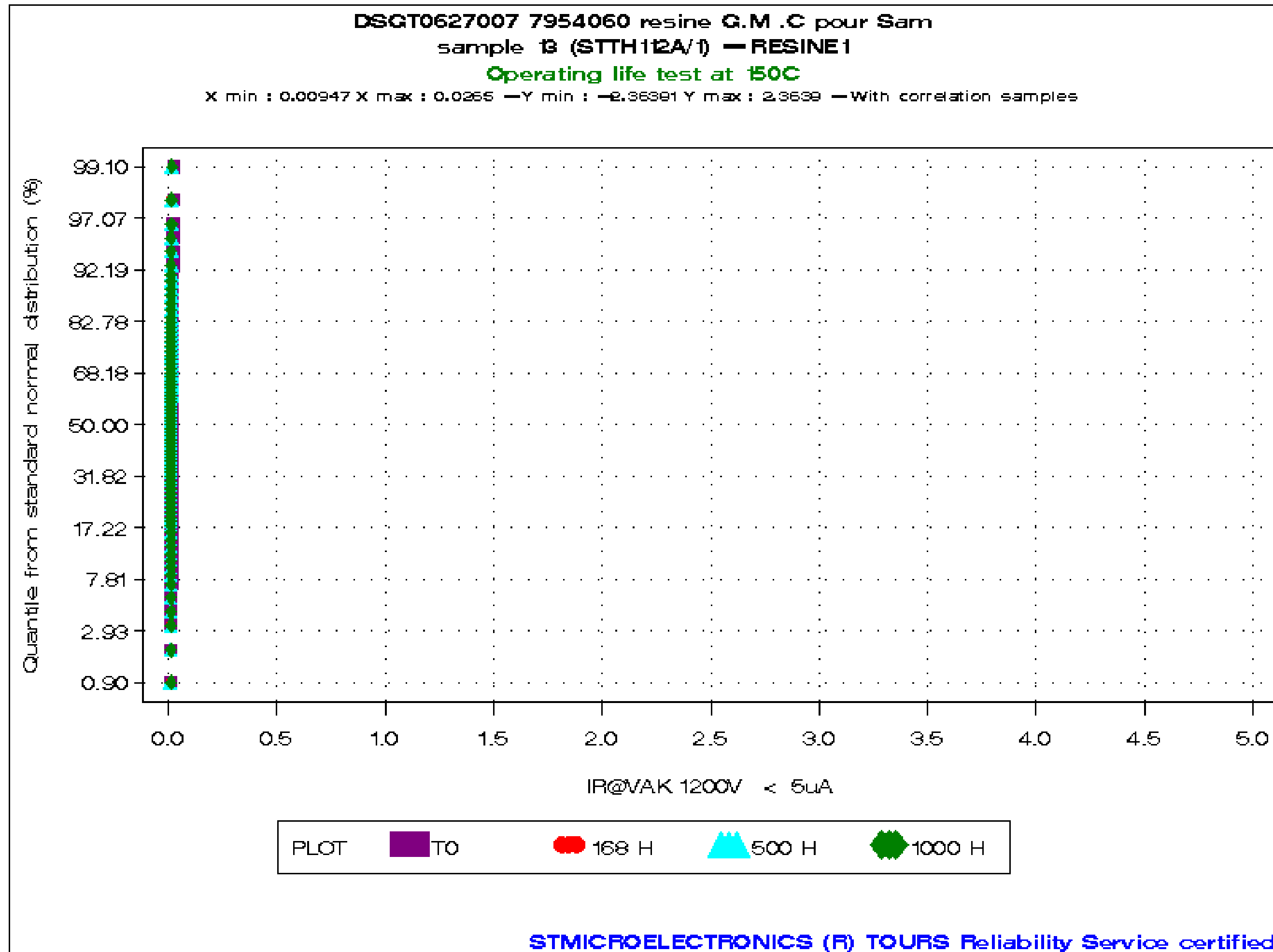
SMA / SMB / SMC package in new Halogen-Free Molding Compound
Assembly location: Morocco

GRAPHS AND STATISTICS FOR HIGH TEMPERATURE REVERSE BIAS (HTRB)



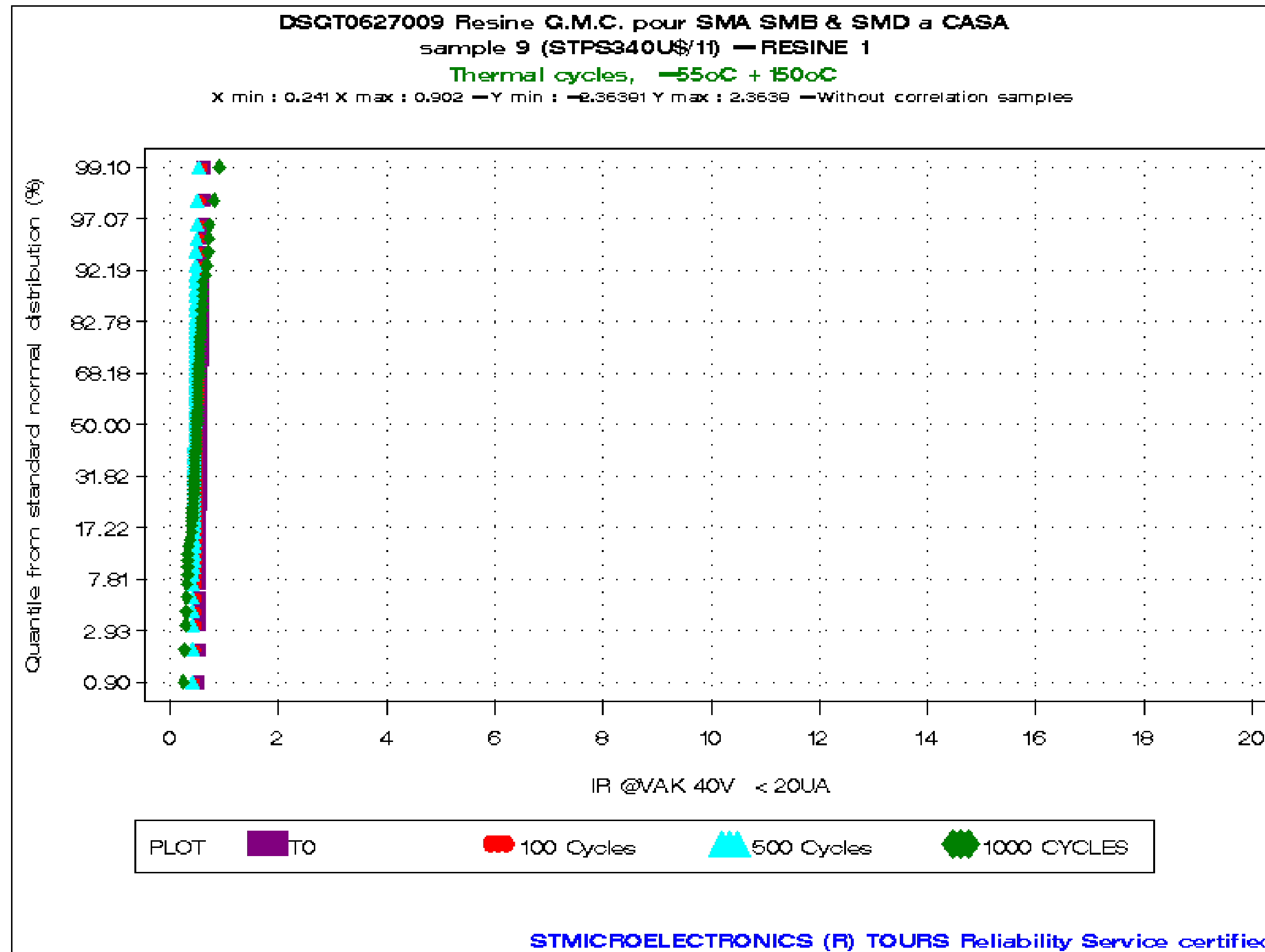
SMA / SMB / SMC package in new Halogen-Free Molding Compound
Assembly location: Morocco

GRAPHS AND STATISTICS FOR INTERMITENT OPERATING LIFE TEST (OLT)



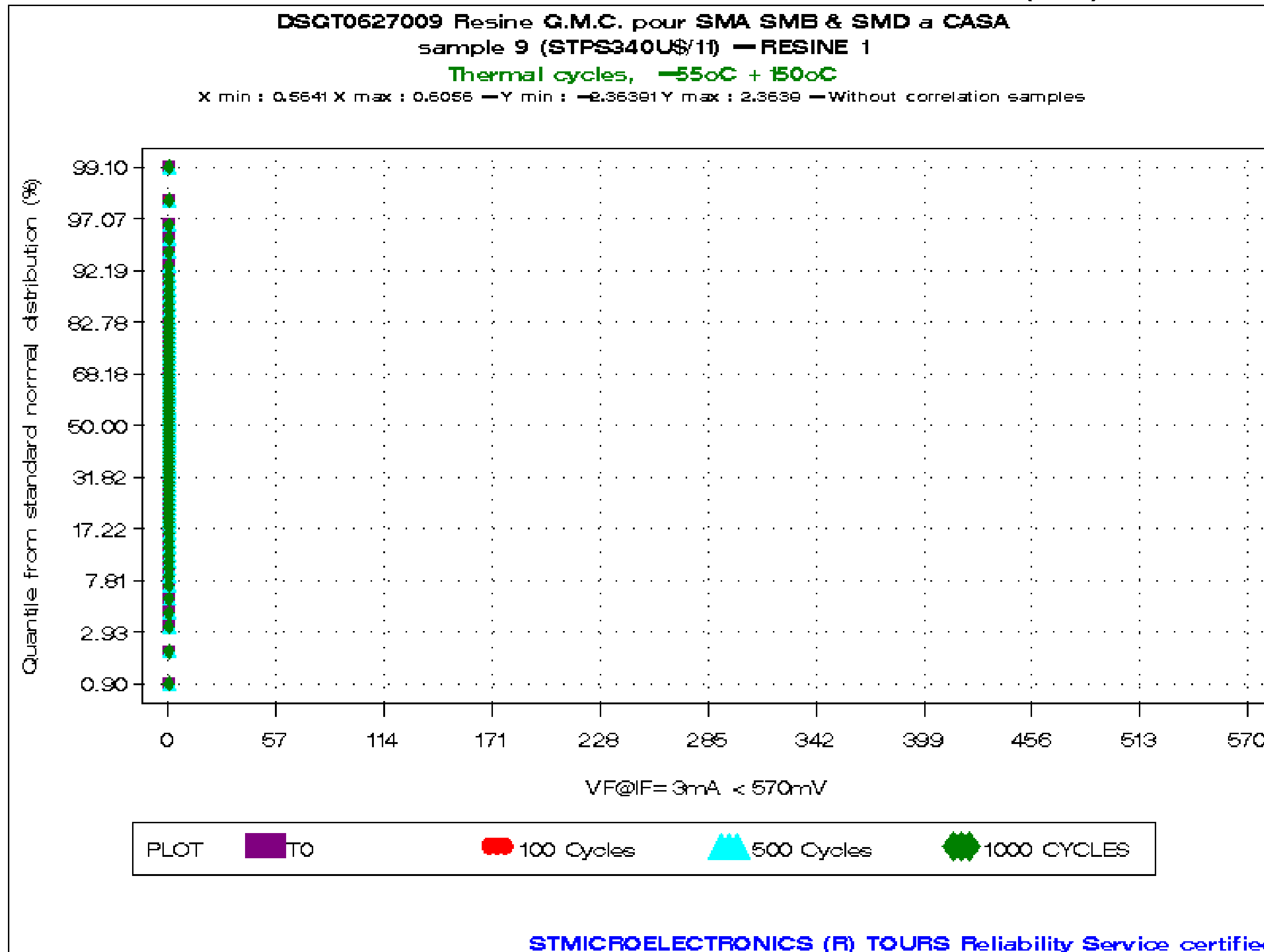
SMA / SMB / SMC package in new Halogen-Free Molding Compound
Assembly location: Morocco

GRAPHS AND STATISTICS FOR THERMAL CYCLING (TCT)



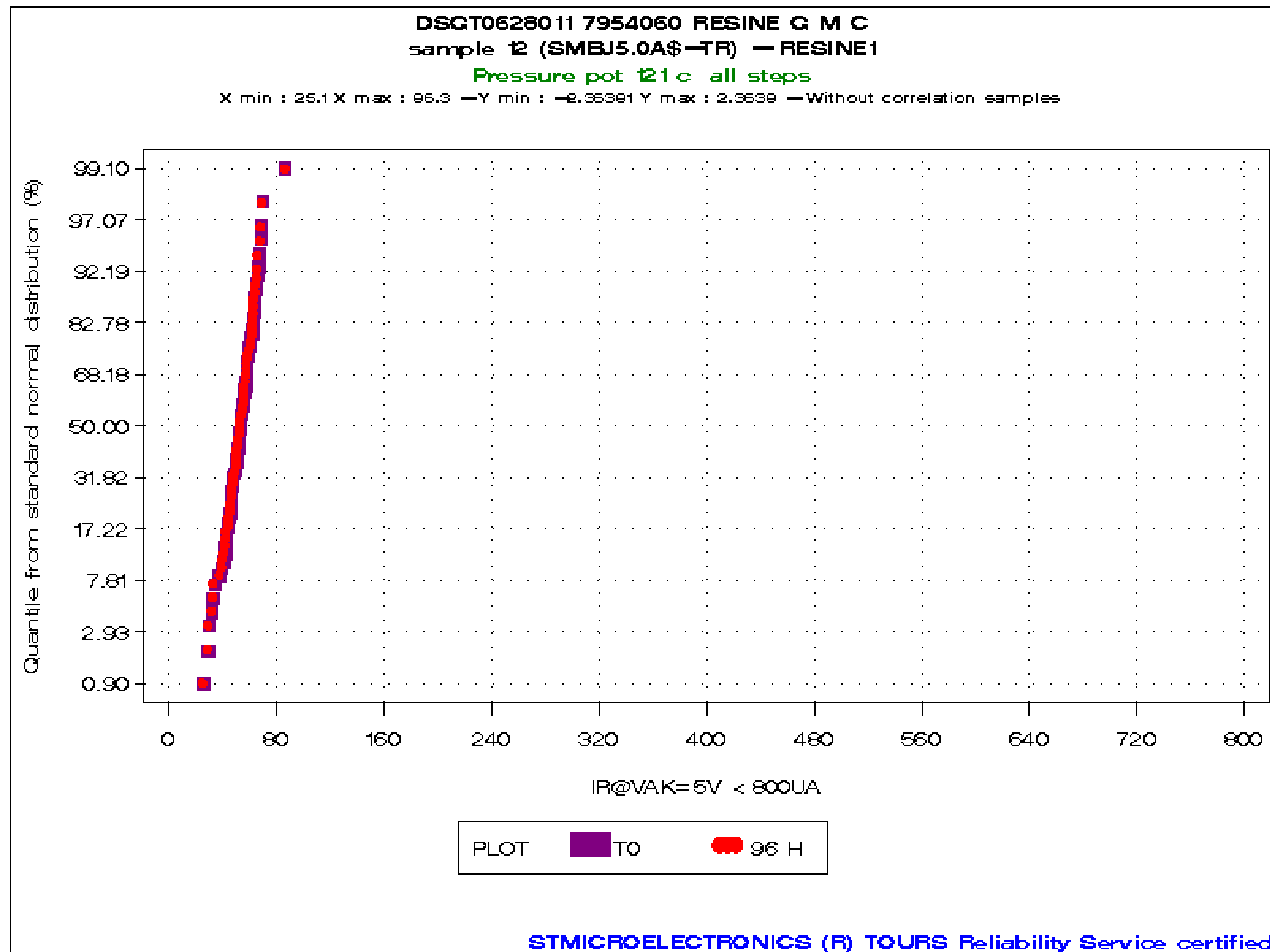
SMA / SMB / SMC package in new Halogen-Free Molding Compound *Assembly location: Morocco*

GRAPHS AND STATISTICS FOR THERMAL CYCLING (TCT)



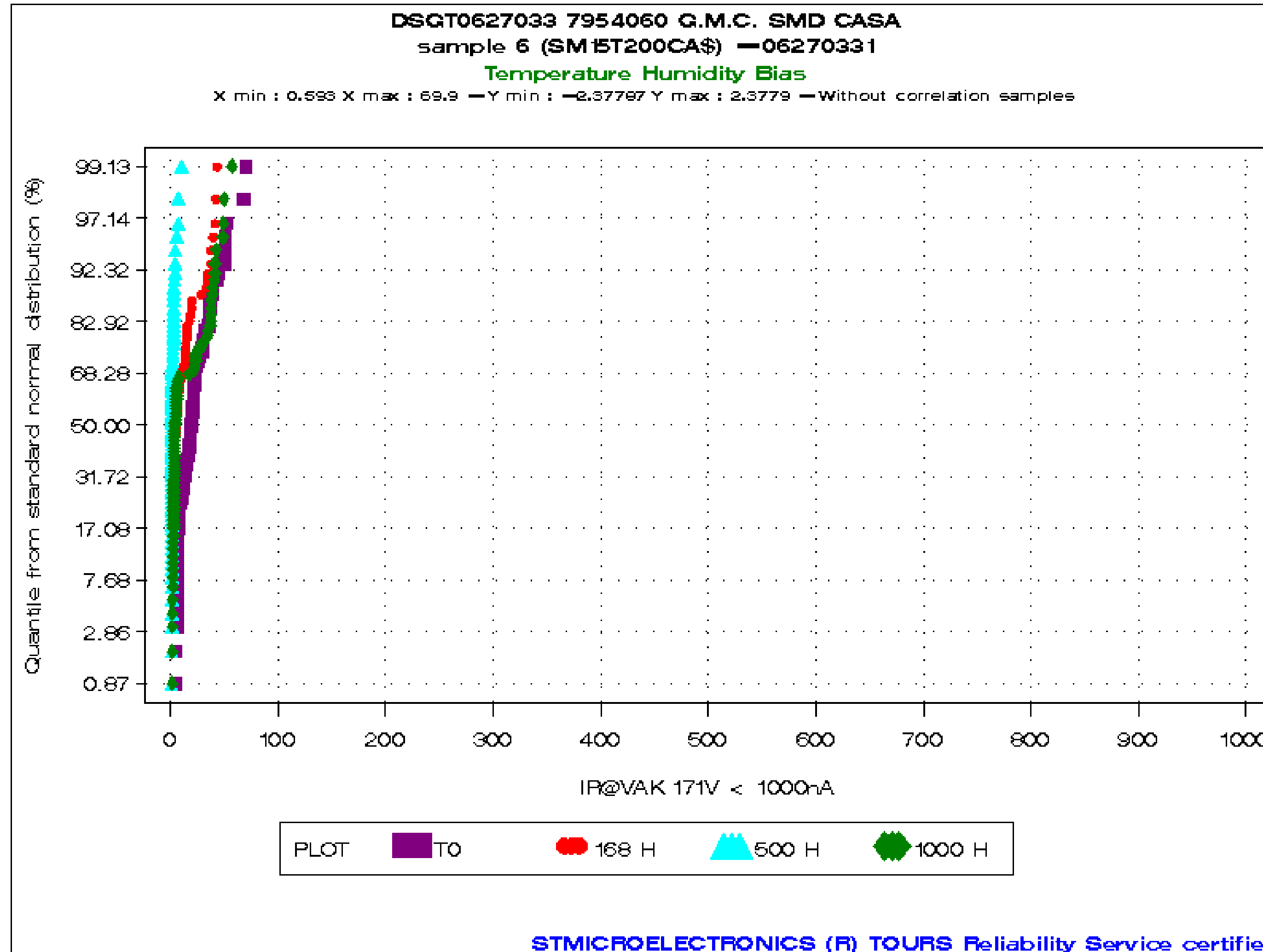
SMA / SMB / SMC package in new Halogen-Free Molding Compound
Assembly location: Morocco

GRAPHS AND STATISTICS FOR AUTOCLAVE TEST (PCT)



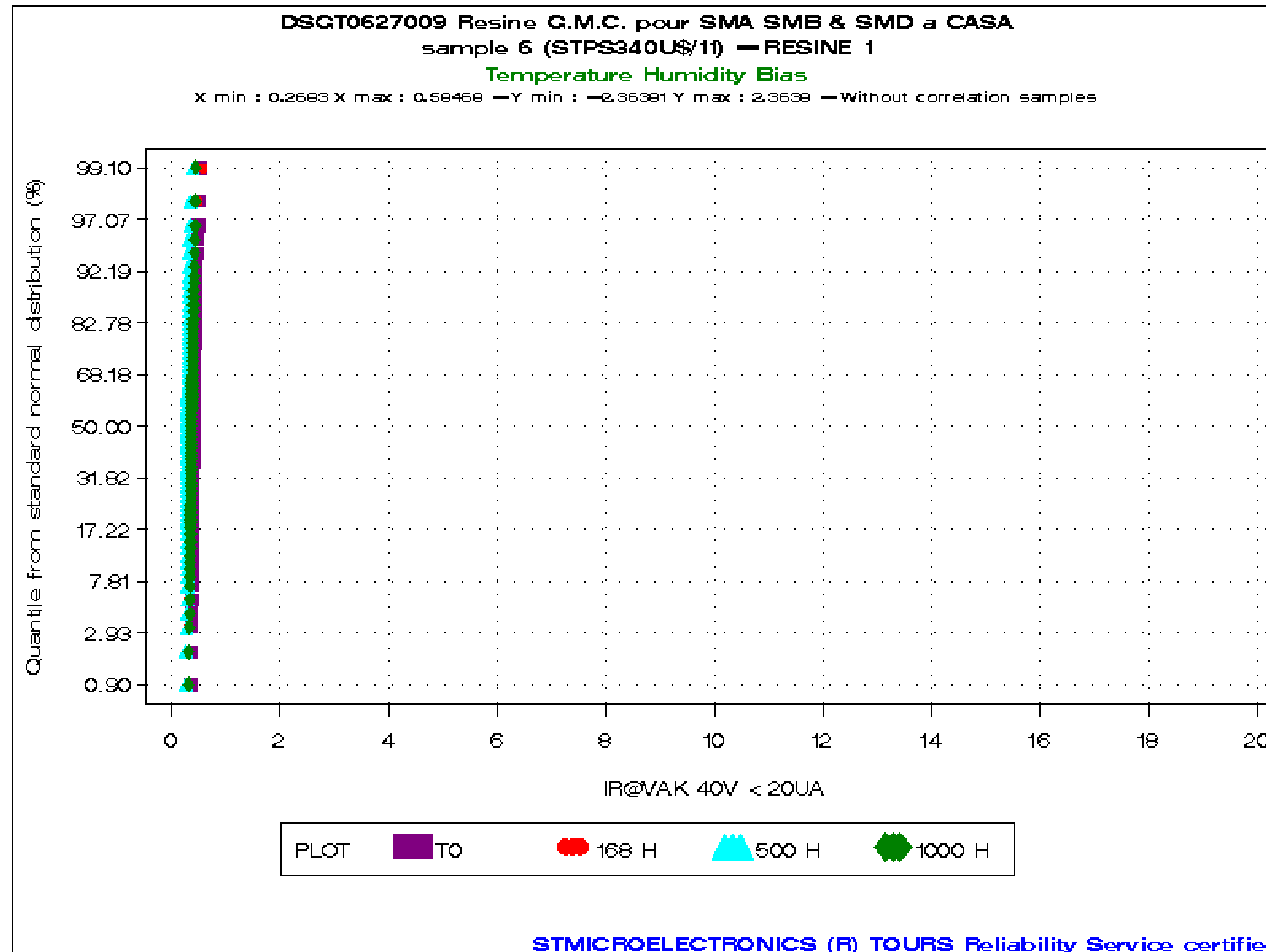
SMA / SMB / SMC package in new Halogen-Free Molding Compound
Assembly location: Morocco

GRAPHS AND STATISTICS FOR THB



SMA / SMB / SMC package in new Halogen-Free Molding Compound Assembly location: Morocco

GRAPHS AND STATISTICS FOR THB



SMA / SMB / SMC package in new Halogen-Free Molding Compound
Assembly location: Morocco

AVERAGE OUTGOING QUALITY LEVEL AT FINAL GATE

Sampling plans at Final quality inspection prior to shipment:

- 200 units per lot for electrical inspection. Acceptance criteria = 0/1
- 315 units per lot for visual and mechanical inspection. Acceptance criteria = 0/1

Ppm calculation:

$$\textbf{Average Output Quality Estimator} = \frac{\text{Total number of defectives on samples with } d \leq (c+1)}{\text{Total number of inspected units in accepted lots}} \times 10^{6}$$

where d = defectives on sample
c = acceptance criteria

PARAMETER INSPECTED	INSPECTION LEVEL	AQL
VISUAL and MECHANICAL	II	0.04%
ELECTRICAL	II	0.065%

SMA / SMB / SMC package in new Halogen-Free Molding Compound
Assembly location: Morocco

ASSESSMENT

AEC-Q101 Qualification Plan requirements have been fulfilled without exception.
It is stressed that reliability tests have shown that the devices behave correctly against environmental tests (no failure). Moreover, the stability of electrical parameters during the accelerated tests demonstrates the ruggedness of the products and safe operation, which is consequently expected during their lifetime.

Completion date	Location	Department	Name
July 20th, 2009	STMicroelectronics Rue Pierre et Marie CURIE BP155 37071 TOURS Cedex 2, FRANCE	Product Quality Assurance	Didier PELTIER Quality Assurance Products E-mail : didier.peltier@st.com

QUALIFICATION REPORT

SMD package in new Halogen-Free molding compound

Assembly location: Subcontractor in China

Author : Didier PELTIER
IMS – ASD&IPAD Division
Quality Assurance ST Tours

Ref: 08217QRP Rev: A
Date: 24-Oct-2008

REVISION TRACKING

Revision	Date	Description of revision	Name
A	24-Oct-2008	Creation	DP

SMD package in new Halogen-Free Molding Compound
Assembly location: Subcontractor in China

CONTENTS

- Why this change

- Product range.

- Basics of die technology.

- Basics of package technology.

- QC process flow chart.

- Qualification plan : Guidelines and description / Reliability tests selection.

- Reliability evaluation : Tests conditions / Results.

- Average Outgoing Quality level.

- Assessment.

WHY THIS CHANGE

Why this change?

In order to meet the global market trend aiming at restricting the Brominated, Chlorinated and Antimony Trioxide based flame retardants, ST announces the conversion of its SMD package epoxy moulding compound to halogen-free.
Such material is considered halogen-free when the concentration of Brominated compound, Chlorinated compound and Sb_2O_3 are each inferior to 1000 ppm of the plastic weight of the component.

What is the change?

The current epoxy moulding compound will be replaced by the halogen-free molding compound with no other change in the assembly Bill Of Material of the components.
Same test and assembly process will continue to be implemented, with no impact on the mechanical, thermal and electrical parameters of the products with reference to the product datasheets. This was verified in this qualification program.
The product marking will be maintained identical with no change with respect to the compliance with the RoHS* directive. There will be no change in the MSL (moisture sensitivity level 1), packing mode and the standard delivery quantitiy.

SMD package in new Halogen-Free Molding Compound
Assembly location: Subcontractor in China

PRODUCT RANGE

Package	Product family	Series
SMA	Protection	SMAJxxx,
	Rectifier	STPSxxxA, STTHxxxA
SMB	Protection	SMBJxxx, SM6Txxx,
	Rectifier	SMBYTxxx, STPSxxxU, STPSxxxS
SMC	Protection	SMCJxxx, SM15Txxx, LNBTVSxxxS
	Rectifier	SMBYTxxx, STPSxxxS, STPSxxxS

BASICS OF DIE TECHNOLOGY

Die / diffusion plant locations:

- ST Microelectronics Tours (France)
- ST Ang Mo Kio (Singapore)

SMD package in new Halogen-Free Molding Compound
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BASICS OF PACKAGE TECHNOLOGY

ASSEMBLY DESCRIPTION

Product family	Die attach material	Bonding material	Frame material	Lead finish material	Package	Molding compound(*)
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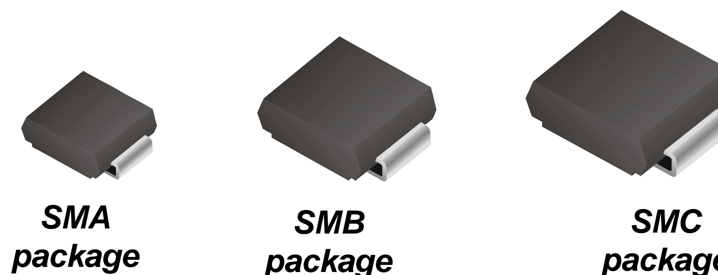
Rectifier						

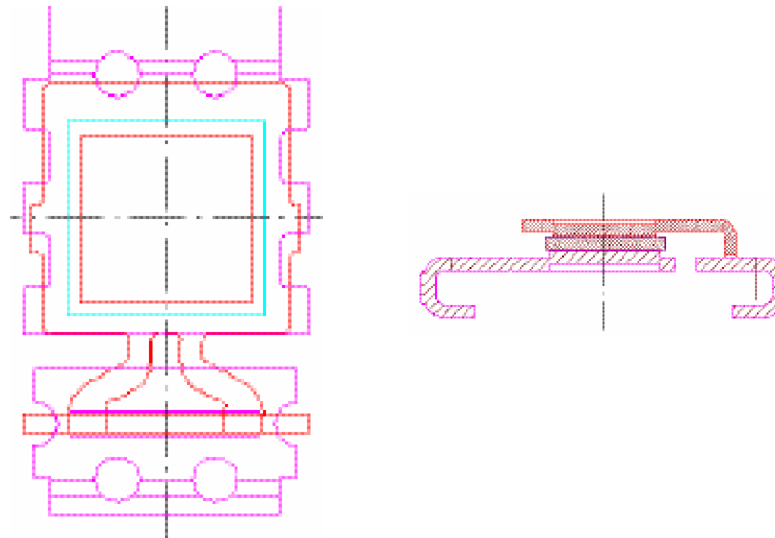
(*): epoxy resin is halogen free and flammability is rated UL94V0



ASSEMBLY / TEST PLANT LOCATION : Subcontractor in China

BASICS OF PACKAGE TECHNOLOGY

INNER ASSEMBLY STRUCTURE



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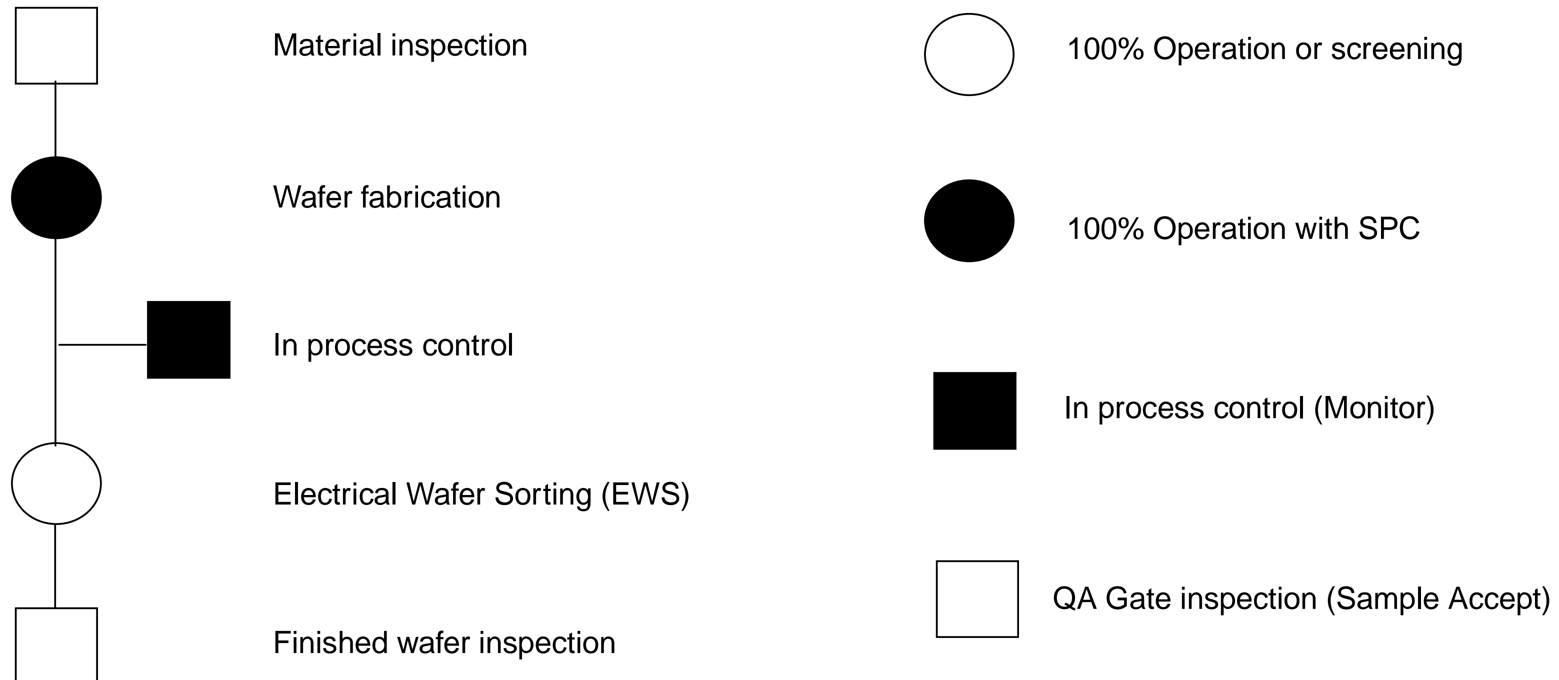
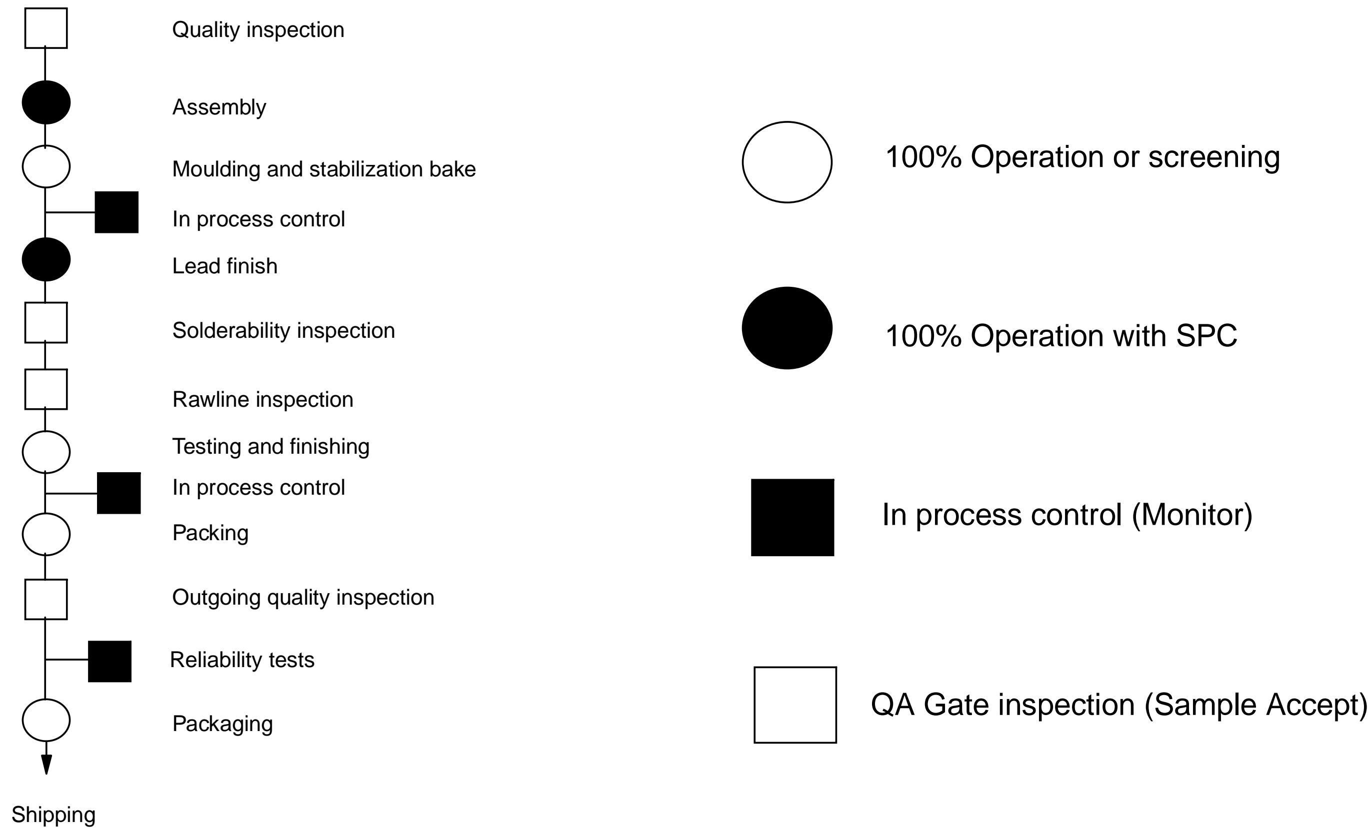
SMD package in new Halogen-Free Molding Compound
Assembly location: Subcontractor in China

QC PROCESS FRONT END FLOW CHART

Wafer Fab standard production process flow chart



SMD package in new Halogen-Free Molding Compound
Assembly location: Subcontractor in China



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The attached sheets provide relevant information on applicable tests, international standards, failure point, failure process, sample size as well as acceptance numbers.

SMD package in new Halogen-Free Molding Compound
Assembly location: Subcontractor in China

RELIABILITY : ABBREVIATIONS AND MEANINGS

* Failure point	: Physical localization of failure.
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* Accelerating factor	:The physical or chemical factor increasing the failure rate.
•Confidence level	: A 60% confidence level means there is a 60% possibility that the sample came from a population whose failure rate does not exceed the given failure rate.
* Ea	: Activation energy (eV : electron volt). Activation energy is introduced in Arrhenius law It is representative of the failure mechanism involved. Ex : 1eV is used to modelize failure rate when surface charges are involved.

SMD package in new Halogen-Free Molding Compound
Assembly location: Subcontractor in China

RELIABILITY : DIE ORIENTED TESTS

TEST DESCRIPTIONS	FAILURE POINT	FAILURE PROCESS	ACCELERATING FACTORS / ACTIV. ENERGY
HIGH TEMPERATURE REVERSE BIAS (HTRB) JESD22 A-108 For protection, Tj; VR ; 1000Hrs For rectifier: Tj; 0.8xVRRM ; 1000Hrs	PASSIVATION LAYERS	SURFACE CHARGES ACCUMULATION	TEMPERATURE ELECTRICAL FIELD Ea = 1.0 eV

SMD package in new Halogen-Free Molding Compound
Assembly location: Subcontractor in China

RELIABILITY : PACKAGE ORIENTED TESTS

TEST DESCRIPTIONS	FAILURE POINT	FAILURE PROCESS	ACCELERATING FACTORS / ACTIV. ENERGY
THERMAL CYCLING (TCT) JESD22 A-104 -65°C/+150°C ; Air / Air ; 1000Cycles	DIE VOLUME DIE ATTACH INTERFACE PASSIVATION LAYERS	SILICON / PACKAGE THERMAL EXPANSION COEFFICIENT MISMATCH	T EXTREMES IN CYCLING
AUTOCLAVE TEST (PCT) JESD22 A-102 121°C, 2bars, 100%RH, 96hrs	DIE PERIPHERY PASSIVATION	POOR HERMETICITY CONTAMINATION	TEMPERATURE / PRESSURE
TEMPERATURE HUMIDITY BIAS (THB) JESD22 A-101 85°C 85%RH ; device reverse biased at 0.8xVrrm up to a maximum of 100V ; 1000Hrs	DIE PERIPHERY PASSIVATION BONDS METALLISATION	POOR HERMETICITY CONTAMINATION CORROSION	HUMIDITY TEMPERATURE VOLTAGE Ea=0.8eV
SOLDERABILITY J-STD-002	LEAD SURFACE	PLATING OR DIPPING PROCESS MATERIAL	AGING HUMIDITY TEMPERATURE
RESISTANCE TO SOLDER HEAT (RSH) JESD22 B-106-A	DIE VOLUME DIE ATTACH INTERFACE PASSIVATION LAYERS	SILICON / PACKAGE THERMAL EXPANSION COEFFICIENT MISMATCH	TEMPERATURE EXTREME

SMD package in new Halogen-Free Molding Compound
Assembly location: Subcontractor in China

RELIABILITY : DIE ORIENTED TESTS CONDITIONS / RESULTS

RELIABILITY TEST	TEST CONDITIONS	RUNNER(*)	RESULTS	EXAMPLE OF DRIFT ANALYSIS
HIGH TEMPERATURE REVERSE BIAS (HTRB) JESD22 A-108	For Rectifier Tj , V=0.8xVR, 1000hrs For Protection Tj, V=Vr, 1000hrs	SM6T68A	0 / 77	Refer to graph #1
		LNBTVS-6-304S	0 / 77	-
		STTH310S	0 / 77	Refer to graph #2

Note 1: *failure criteria :electrical parameter as defined in product data sheet.*

(*) selected as per structural similarities procedures according to AEC-Q101.

SMD package in new Halogen-Free Molding Compound
Assembly location: Subcontractor in China

RELIABILITY : PACKAGE ORIENTED TESTS CONDITIONS / RESULTS

RELIABILITY TEST	TEST CONDITIONS	RUNNER(*)	RESULTS	EXAMPLE OF DRIFT ANALYSIS
THERMAL CYCLING (TCT) JESD22 A-104	-65°C/+150°C, 500cycles	LNBTVS6-304S	0 / 77	Refer to graph #3
U-HAST TEST JESD22A-110-B	130°C / 100%RH / 96Hrs	LNBTVS6-304S	0 / 25	-
		SMBJ13A	0 / 25	Refer to graph #4
		SMAJ5.0A	0 / 25	Refer to graph #5
TEMPERATURE HUMIDITY BIAS (THB) JESD22 A-101	85°C 85%RH; V=0.8xVR (<100V); 1000Hrs	SM6T68A	0 / 25	Refer to graph #6
		STTH1L06A	0 / 25	Refer to graph #7
		LNBTVS6-304S	0 / 25	-

Note 1: *failure criteria :electrical parameter as defined in product data sheet.*

Note 2: *All surface mount devices (SMD's) submitted to pre-conditionning prior reliability test as per JEDEC JESD22-A113.*

(*) selected as per structural similarities procedures according to AEC-Q101.

SMD package in new Halogen-Free Molding Compound
Assembly location: Subcontractor in China

RELIABILITY : PACKAGE ORIENTED TESTS CONDITIONS / RESULTS

RELIABILITY TEST	TEST CONDITIONS	RUNNER(*)	RESULTS
SOLDERABILITY J-STD-002	- Dry aging (150°C, 16Hrs) solderability test 220°C / PbSn - Dry aging (150°C, 16Hrs) solderability test 245°C / SnAgCu - Steam aging (100°C, 8Hrs) solderability test 220°C / PbSn - Steam aging (100°C, 8Hrs) solderability test 245°C / SnAgCu	SMAJ33CA	0 / 60
		SM6T68A	0 / 60
		LNBTVS6-304S	0 / 60
RSH (Resistance to Solder Heat) JESD22 B-106-A	T = 260°C / 10s ON / 15s OFF (2 times)	SMAJ33CA	0 / 12
		SM6T68A	0 / 12
		LNBTVS6-304S	0 / 12

Note 1: *failure criteria :electrical parameter as defined in product data sheet.*

Note 2: *All surface mount devices (SMD's) submitted to pre-conditionning prior reliability test as per JEDEC JESD22-A113.*

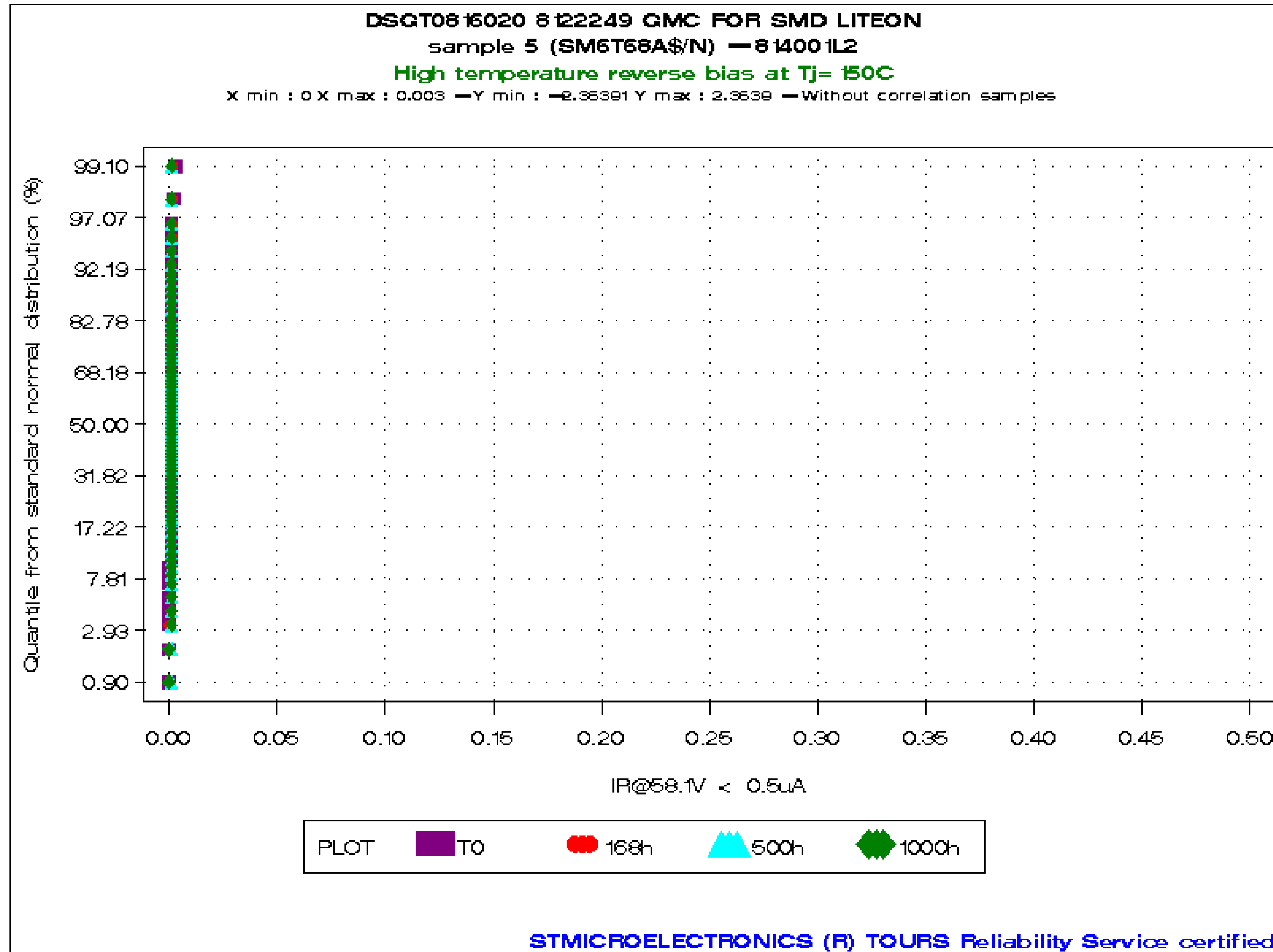
(*) selected as per structural similarities procedures according to AEC-Q101.

RELIABILITY DATA : STATISTICS

In addition to the above table of results, the following graphs provide a straightforward data analysis with a representation of the selected parameter population in the Henry's chart.
Since the « y » axis represents the cumulative population of the different read-outs, statistical analysis is easy (median, range), while the overall stability and span during the stress test is immediately evident.

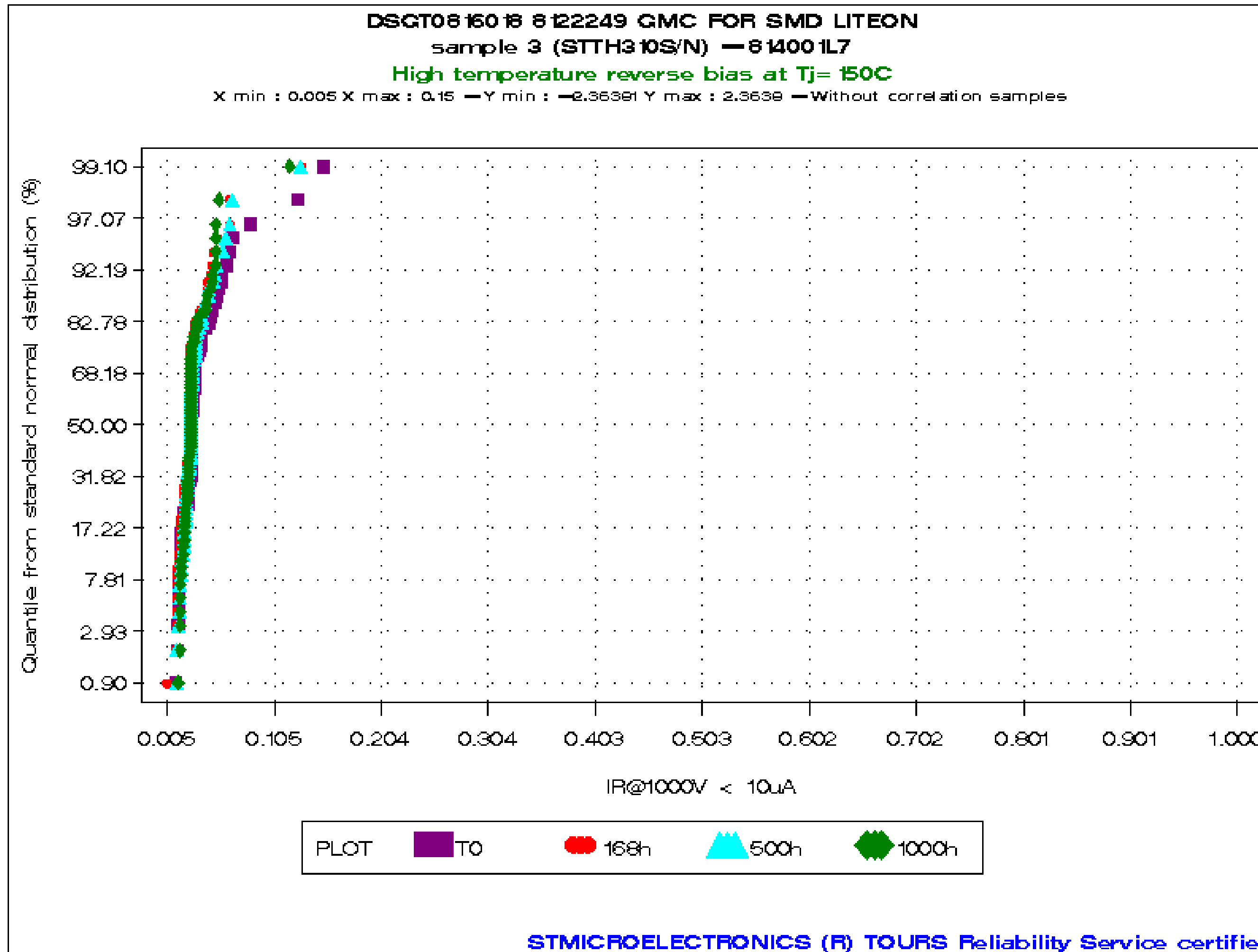
SMD package in new Halogen-Free Molding Compound
Assembly location: Subcontractor in China

GRAPHS AND STATISTICS FOR HIGH TEMPERATURE REVERSE BIAS (HTRB)
Graph #1



SMD package in new Halogen-Free Molding Compound
Assembly location: Subcontractor in China

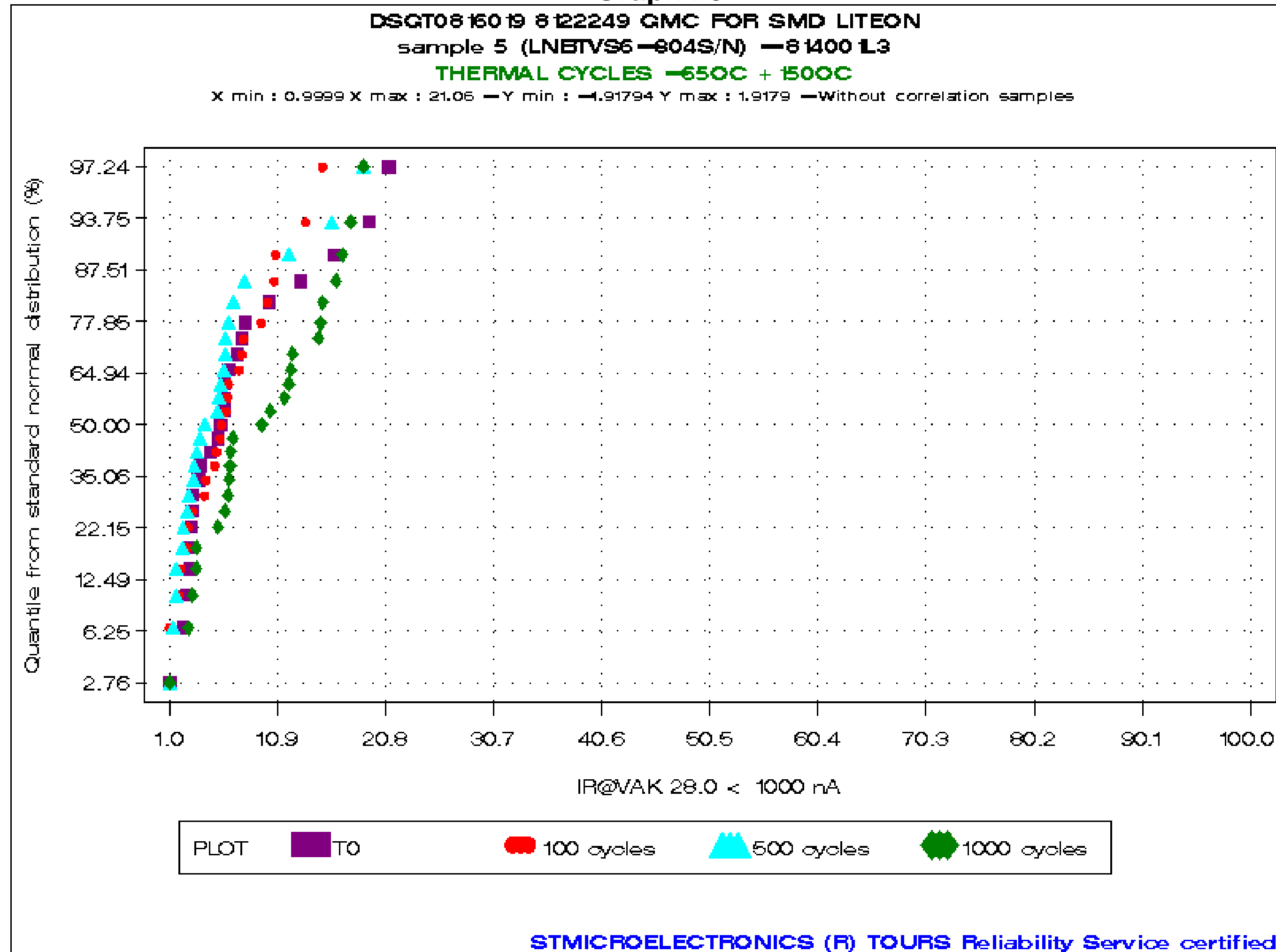
GRAPHS AND STATISTICS FOR HIGH TEMPERATURE REVERSE BIAS (HTRB)
Graph #2



SMD package in new Halogen-Free Molding Compound
Assembly location: Subcontractor in China

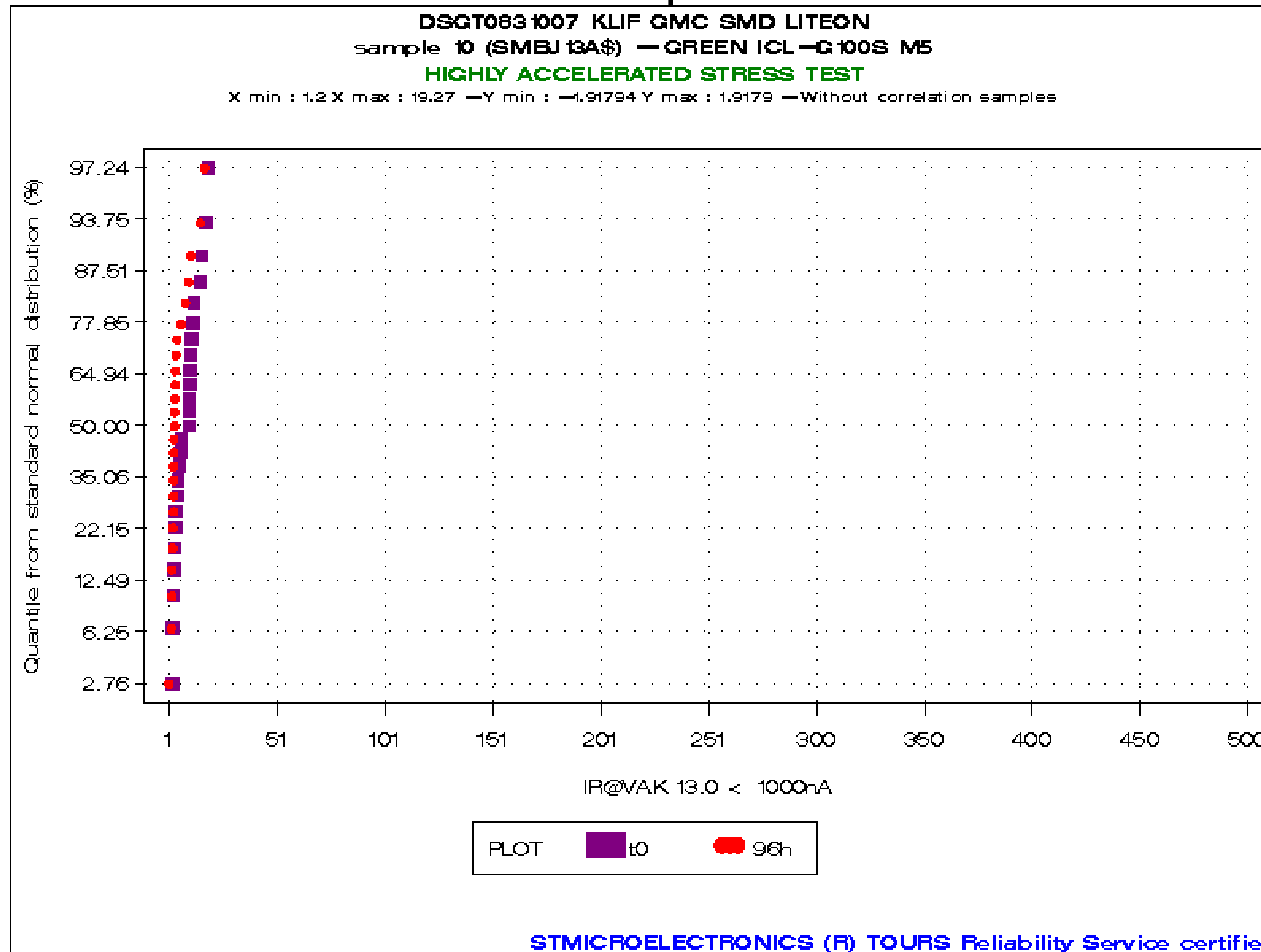
GRAPHS AND STATISTICS FOR THERMAL CYCLING (TCT)

Graph #3



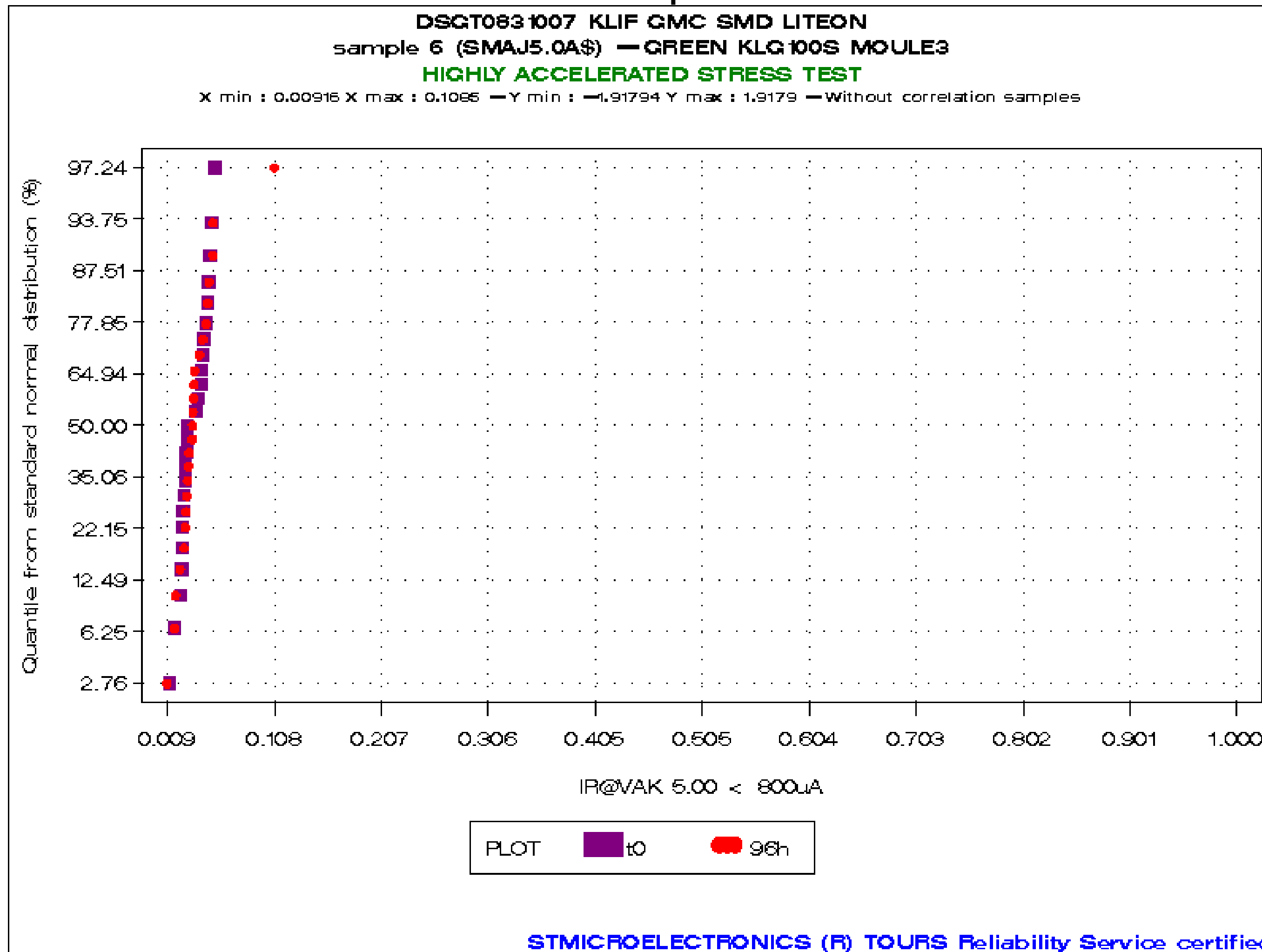
SMD package in new Halogen-Free Molding Compound
Assembly location: Subcontractor in China

GRAPHS AND STATISTICS FOR U-HAST
Graph #4



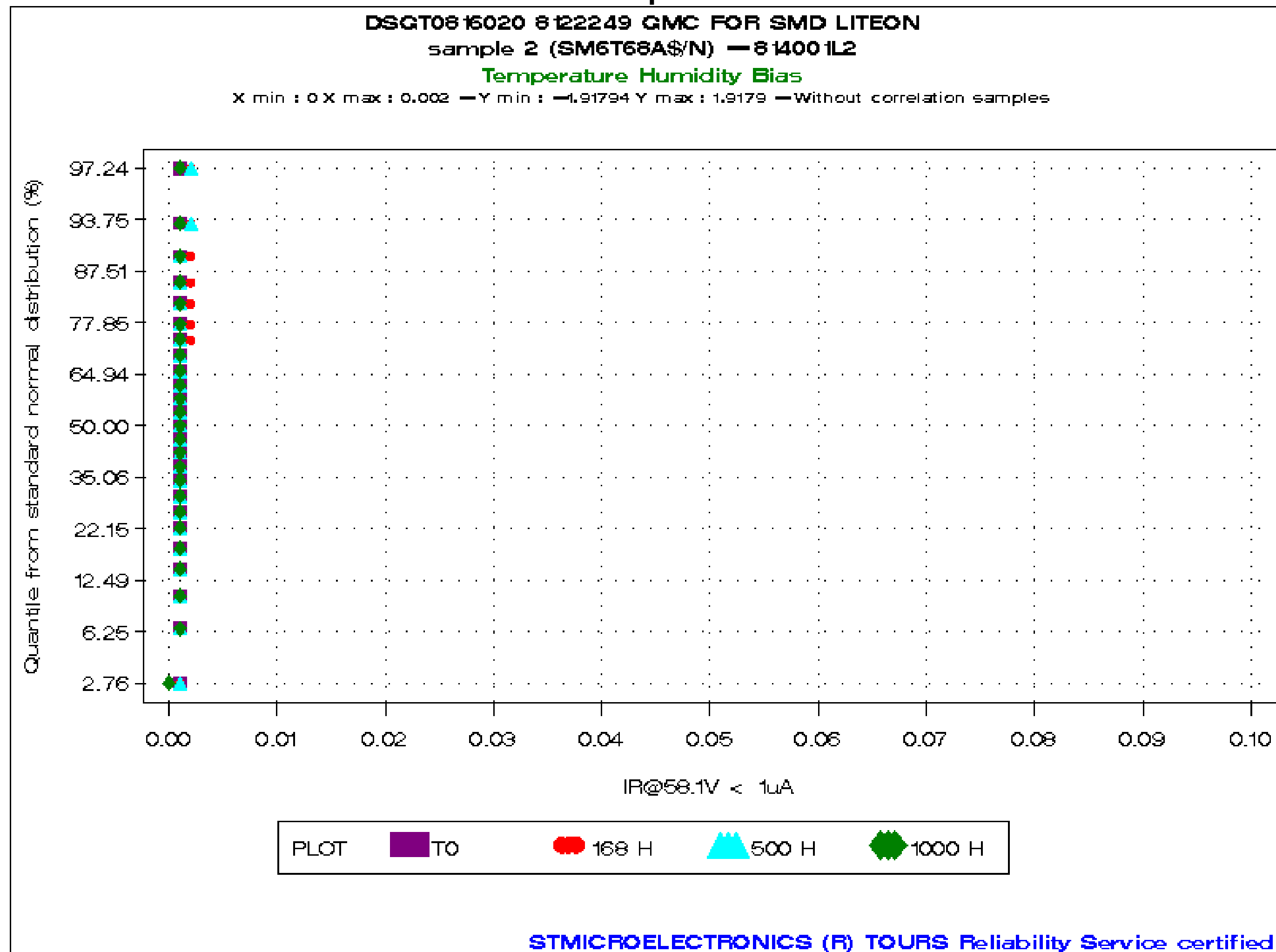
SMD package in new Halogen-Free Molding Compound
Assembly location: Subcontractor in China

GRAPHS AND STATISTICS FOR U-HAST
Graph #5



SMD package in new Halogen-Free Molding Compound
Assembly location: Subcontractor in China

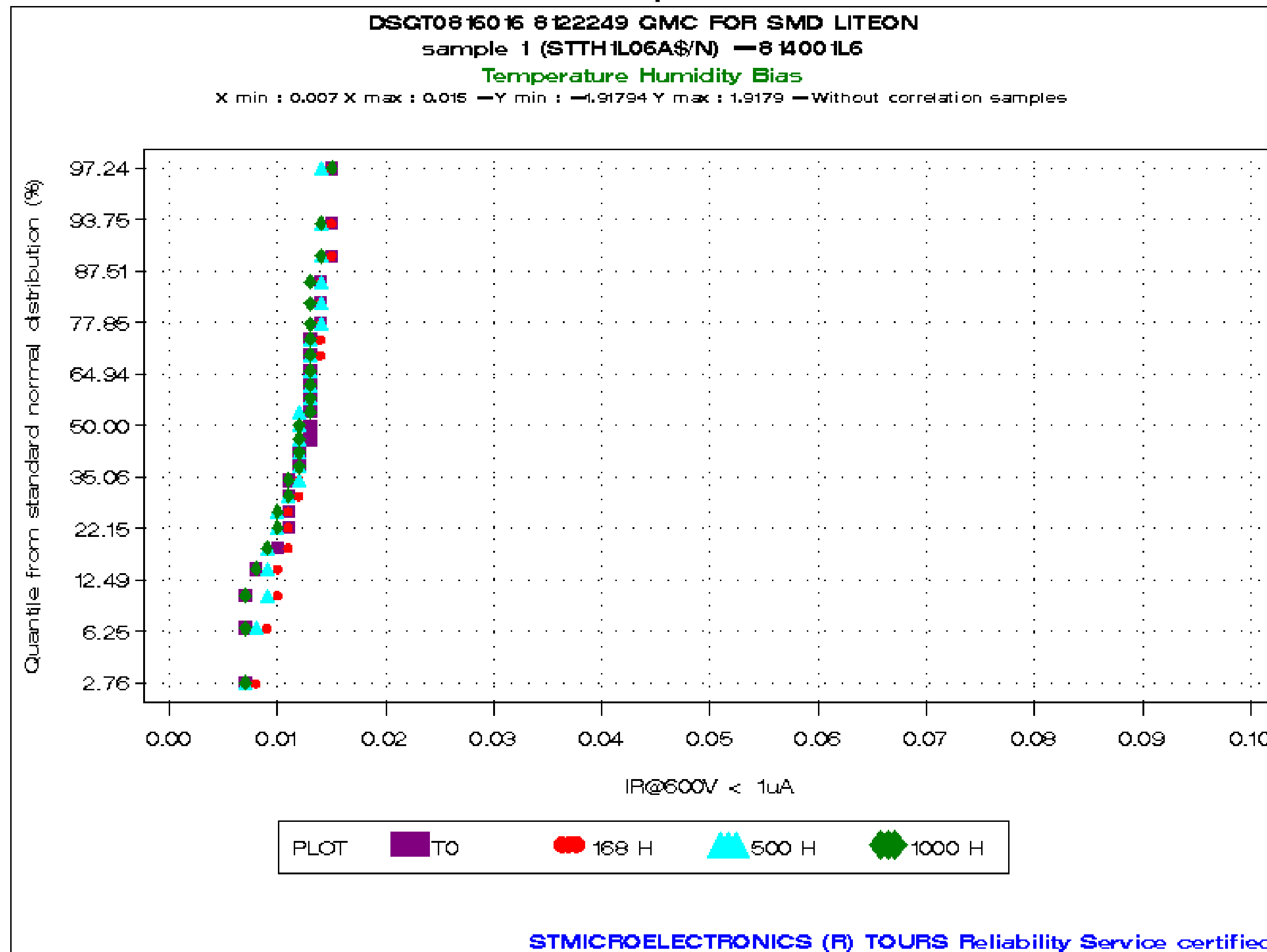
GRAPHS AND STATISTICS FOR THB
Graph #6



SMD package in new Halogen-Free Molding Compound
Assembly location: Subcontractor in China

GRAPHS AND STATISTICS FOR THB

Graph #7



SMD package in new Halogen-Free Molding Compound
Assembly location: Subcontractor in China

AVERAGE OUTGOING QUALITY LEVEL AT FINAL GATE

Sampling plans at Final quality inspection prior to shipment:

- 200 units per lot for electrical inspection. Acceptance criteria = 0/1
- 315 units per lot for visual and mechanical inspection. Acceptance criteria = 0/1

Ppm calculation:

$$\textbf{Average Output Quality Estimator} = \frac{\text{Total number of defectives on samples with } d \leq (c+1)}{\text{Total number of inspected units in accepted lots}} \times 10^6$$

where d = defectives on sample
c = acceptance criteria

PARAMETER INSPECTED	INSPECTION LEVEL	AQL
VISUAL and MECHANICAL	II	0.04%
ELECTRICAL	II	0.065%

ASSESSMENT

AEC-Q101 Qualification Plan requirements have been fulfilled without exception.
It is stressed that reliability tests have shown that the devices behave correctly against environmental tests (no failure). Moreover, the stability of electrical parameters during the accelerated tests demonstrates the ruggedness of the products and safe operation, which is consequently expected during their lifetime.

Completion date	Location	Department	Name
Oct 24th, 2008	STMicroelectronics Rue Pierre et Marie CURIE BP155 37071 TOURS Cedex 2, FRANCE	Product Quality Assurance	Didier PELTIER Quality Assurance Products E-mail : didier.peltier@st.com

QUALIFICATION REPORT

Die layout optimization for transil™ standard

General Information	
Product Line	*Transil standard*
Product Description	*Devices designed specifically for protection sensitive equipment against transient electrical overstress.*
P/N	*Refer to table of involved products (Paragraph 3.1)*
Product Group	*APM*
Product division	*ASD & IPAD*
Package	*SMA and SMB*
Silicon Process technology	*Transil planar*
Maturity level step	*30*

Locations	
Wafer fab	*STMicroelectronis Tours (France)*
Assembly plant	*- STMicroelectronics Bouskoura (MOROCCO)* *- Subcontractor in CHINA*
Reliability Lab	*STMicroelectronis Tours (FRANCE)*

DOCUMENT INFORMATION

Version	Date	Pages	Prepared by	Comment
1.0	07-Nov-2008	9	D.PELTIER	First issue

Note: This report is a summary of the reliability trials performed in good faith by STMicroelectronics in order to evaluate the potential reliability risks during the product life using a set of defined test methods.
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TABLE OF CONTENTS

1 APPLICABLE AND REFERENCE DOCUMENTS 3
2 GLOSSARY 3
3 RELIABILITY EVALUATION OVERVIEW 3
3.1 OBJECTIVES 3
3.2 CONCLUSION 3
4 DEVICE CHARACTERISTICS 4
4.1 DEVICE DESCRIPTION 4
4.2 CONSTRUCTION NOTE 4
5 TESTS RESULTS SUMMARY 5
5.1 TEST VEHICLE 5
5.2 TEST PLAN AND RESULTS SUMMARY 5
6 ANNEXES 8
6.1 DEVICE DETAILS 8
6.2 TESTS DESCRIPTION 9
6.3 DRIFT ANALYSIS .... **ERROR! BOOKMARK NOT DEFINED.**

1 APPLICABLE AND REFERENCE DOCUMENTS

Document reference	Short description
AEC-Q100	Stress test qualification for automotive grade integrated circuits
AEC-Q101	Stress test qualification for automotive grade discrete semiconductors
JESD47	Stress-Test-Driven Qualification of Integrated Circuits

2 GLOSSARY

DUT	Device Under Test
PCB	Printed Circuit Board
SS	Sample Size

3 RELIABILITY EVALUATION OVERVIEW

3.1 Objectives

Qualification of die layout optimization on the following products:

Product	Package
SMAJ5.0A-TR…SMAJ70A-TR SMAJ5.0CA-TR…SMAJ70CA-TR	SMA
SM6T6V8A … SM6T75A SM6T6V8CA … SM6T75CA SMBJ5.0A-TR…SMBJ70A-TR SMBJ5.0CA-TR…SMBJ70CA-TR	SMB

3.2 Conclusion

Qualification Plan requirements have been fulfilled without exception. It is stressed that reliability tests have shown that the devices behave correctly against environmental tests (no failure). Moreover, the stability of electrical parameters during the accelerated tests demonstrates the ruggedness of the products and safe operation, which is consequently expected during their lifetime.

4 DEVICE CHARACTERISTICS

4.1 Device description

Devices designed specifically for protection sensitive equipment against transient electrical overstress.

4.2 Construction note

	Transil standard
Wafer/Die fab. information	
Wafer fab manufacturing location	STMicroelectronics Tours (France)
Technology	Planar
Process family	Transil standard
Die finishing back side	Al / Ni / Au
Die size	SMAJxxxx: 1.25mm x 1.25mm x 300µm SMBJxxxx and SM6Txxxx: 1.5mm x 1.5mm x 300µm
Bond pad metallization layers	Au
Passivation type	SiO_2
Assembly information	
Assembly site	STMicroelectronics Bouskoura (Morocco) / Subcontractor in China
Package description	SMA / SMB
Molding compound	Green epoxy resin
Frame material	Copper
Die attach material	Soft solder paste
Wire bonding process	N/A as clip used
Wires bonding materials/diameters	N/A as clip used
Lead finishing process	Sn 100% (Lead free)
Final testing information	
Testing location	STMicroelectronics Bouskoura (Morocco) / Subcontractor in China

5 TESTS RESULTS SUMMARY

5.1 Test vehicles

Product	Die process	Package
SMAJ5.0A-TR	Uni-directional transil planar	SMA
SMAJ13A-TR	Uni-directional transil planar	SMA
SMAJ33A-TR	Uni-directional transil planar	SMA
SMAJ33CA-TR	Bi-birectional transil planar	SMA
SMAJ58CA-TR	Bi-birectional transil planar	SMA
SMBJ5.0A-TR	Uni-directional transil planar	SMB
SMBJ13A-TR	Uni-directional transil planar	SMB
SMBJ33CA-TR	Bi-birectional transil planar	SMB
SMBJ58CA-TR	Bi-birectional transil planar	SMB
SMBJ33A-TR	Uni-directional transil planar	SMB
SM6T36CA	Bi-birectional transil planar	SMB
SM6T68A	Uni-directional transil planar	SMB

5.2 Test plan and results summary

SMAJ58CA-TR

Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS Lot 1	Note
Die Oriented Tests							
Repetitive Surge	Y	ADCS0060282	IPP=4.3A/us, waveform 10/1000us	20	100surges	0/20	
					500surges	0/20	
					1000surges	0/20	

SMBJ33A-TR

Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS Lot 1	Note
Die Oriented Tests							
Repetitive Surge	Y	DCS0060282	IPP =11.8A/µs, waveform 10/1000us	20	100surges	0/20	
					500surges	0/20	
					1000surges	0/20	

SMBJ33CA-TR

Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS Lot 1	Note
Die Oriented Tests							
Repetitive Surge	Y	DCS0060282	IPP 11.8A/us, waveform 10/1000us	20	100surges	0/20	
					500surges	0/20	
					1000surges	0/20	

SM6T68A

Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS Lot 1	Note
Die Oriented Tests							
Repetitive Surge	Y	DCS0060282	IPP = 6.5A/us, waveform 10/1000us	20	100surges	0/20	
					500surges	0/20	
					1000surges	0/20	

SMBJ58CA-TR

Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS Lot 1	Note
Die Oriented Tests							
Repetitive Surge	Y	DCS0060282	IPP = 6.7 A/us, waveform 10/1000us	20	100surges	0/20	
					500surges	0/20	
					1000surges	0/20	

SMAJ33A-TR

Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS Lot 1	Note
Die Oriented Tests							
Repetitive Surge	Y	DCS0060282	IPP =11.8A/μs, waveform 10/1000us	20	100surges	0/20	
					500surges	0/20	
					1000surges	0/20	

SMAJ33CA-TR

Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS Lot 1	Note
Die Oriented Tests							
Repetitive Surge	Y	DCS0060282	IPP =11.8A/μs, waveform 10/1000us	20	100surges	0/20	
					500surges	0/20	
					1000surges	0/20	

SMAJ58CA-TR

Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS Lot 1	Note
Die Oriented Tests							
Repetitive Surge	Y	DCS0060282	IPP = 6.7 A/us, waveform 10/1000us	20	100surges	0/20	
					500surges	0/20	
					1000surges	0/20	

SM6T68A / SMBJ5.0A-TR

Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS		Note
						SM6T68A	SMBJ5.0A-TR	
Die Oriented Tests								
HTRB	N	JESD22 A-108	Tj = 150°C, V=Vr	231	168 H	0/77	0/86	
					500 H	0/77	0/86	
					1000 H	0/77	0/86	

SMAJ33A-TR

Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS Lot 1	Note
Package Oriented Tests							
TC	Y	JESD22 A-104	-65°C +150°C, 2 cycles/hour	25	100 cycles	0/25	
					500 cycles	0/25	

SMAJ13A-TR / SM6T36CA

Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS		Note
						SMAJ13A-TR	SM6T36CA	
Package Oriented Tests								
AC	Y	JESD22 A-102c	T=133°C, HR=100% P=2Bars	77	67h	0/77	0/77	
THB	Y	JESD22 A-101	T=85°C HR=85% V= Vr	25	168h	0/20	0/20	
					504h	0/20	0/20	
					1000h	0/20	0/20	

SMAJ5.0A-TR

Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS			Note
						Lot 1	Lot 2	Lot 3	
Package Oriented Tests									
AC	Y	JESD22 A-102	T=121°C, HR=100% P=2Bars	75	96 H	0/25	0/25	0/25	

SMBJ13A-TR

Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS		Note
						Lot 1	Lot 2	
Package Oriented Tests								
AC	Y	JESD22 A-102	T=121°C, HR=100% P=2Bars	50	96 H	0/25	0/25	

SMAJ5.0A-TR

Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS			Note
						Lot 1	Lot 2	Lot 3	
Package Oriented Tests									
u-HAST	Y	JESD22 A-102	T=133°C, HR=85%	75	96 H	0/25	0/25	0/25	

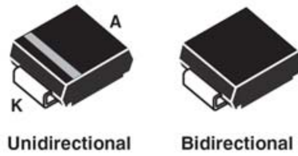
SMBJ13A-TR

Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS		Note
						Lot 1	Lot 2	
Package Oriented Tests								
u-HAST	Y	JESD22 A-102	T=133°C, HR=85%	50	96 H	0/25	0/25	

6 ANNEXES

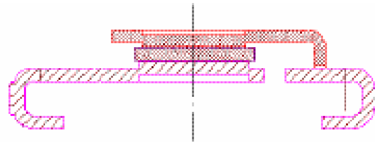
6.1 Device details

6.1.1 Pin connection



For unidirectional units,
there is a cathode band on the package

6.1.2 Bonding diagram



6.1.3 Package outline/Mechanical data

SMA dimensions

Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A1	1.90	2.45	0.075	0.094
A2	0.05	0.20	0.002	0.008
b	1.25	1.65	0.049	0.065
c	0.15	0.40	0.006	0.016
D	2.25	2.90	0.089	0.114
E	4.80	5.35	0.189	0.211
E1	3.95	4.60	0.156	0.181
L	0.75	1.50	0.030	0.059

SMB package dimensions

Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A1	1.90	2.45	0.075	0.096
A2	0.05	0.20	0.002	0.008
b	1.95	2.20	0.077	0.087
c	0.15	0.40	0.006	0.016
D	3.30	3.95	0.130	0.156
E	5.10	5.60	0.201	0.220
E1	4.05	4.60	0.159	0.181
L	0.75	1.50	0.030	0.059

6.2 Tests Description

Test name	Description	Purpose
Die Oriented		
HTRB High Temperature Reverse Bias	The device is stressed in static configuration, trying to satisfy as much as possible the following conditions: low power dissipation; max. supply voltage compatible with diffusion process and internal circuitry limitations;	To determine the effects of bias conditions and temperature on solid state devices over time. It simulates the devices' operating condition in an accelerated way. To maximize the electrical field across either reverse-biased junctions or dielectric layers, in order to investigate the failure modes linked to mobile contamination, oxide ageing, layout sensitivity to surface effects.
Package Oriented		
PC Preconditioning	The device is submitted to a typical temperature profile used for surface mounting devices, after a controlled moisture absorption.	As stand-alone test: to investigate the moisture sensitivity level. As preconditioning before other reliability tests: to verify that the surface mounting stress does not impact on the subsequent reliability performance. The typical failure modes are "pop corn" effect and delamination.
AC Auto Clave (Pressure Pot)	The device is stored in saturated steam, at fixed and controlled conditions of pressure and temperature.	To investigate corrosion phenomena affecting die or package materials, related to chemical contamination and package hermeticity.
TC Temperature Cycling	The device is submitted to cycled temperature excursions, between a hot and a cold chamber in air atmosphere.	To investigate failure modes related to the thermo-mechanical stress induced by the different thermal expansion of the materials interacting in the die-package system. Typical failure modes are linked to metal displacement, dielectric cracking, molding compound delamination, wire-bonds failure, die-attach layer degradation.
THB Temperature Humidity Bias	The device is biased in static configuration minimizing its internal power dissipation, and stored at controlled conditions of ambient temperature and relative humidity.	To evaluate the package moisture resistance with electrical field applied, both electrolytic and galvanic corrosion are put in evidence.

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